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CATALOGUE OF EXISTING M.O.E. GUIDELINES, OBJECTIVES AND PRACTICES GOVERNING THE CLEANUP, HANDLING AND DISPOSAL OF SLUDGES, SOILS AND EXCAVATED MATERIAL

Final Draft

by
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ONTARIO MINISTRY OF THE ENVIRONMENT

MATERIALS POLICY COMMITTEE

JULY 1989

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JULY 1989

HAZARDOUS CONTAMINANTS
COORDINATION BRANCH
135 ST. CLAIR AVENUE WEST
TORONTO, ONTARIO M4V 1P5

EXECUTIVE SUMMARY

This report presents a comprehensive review, the first of its kind to be conducted, of some nineteen different guidelines (see table) that have been developed in whole or part by the Ontario Ministry of the Environment (MOE) which are intended to advise on environmentally "safe" methods of dealing with potentially contaminated sludges, soils and excavated material (including sediments) in the province. For each guideline, the derivation and rationale, parameters and guideline numbers, current status, intended application, and limitations and precautions were identified.

The review of the MOE guidelines revealed a number of policy issues, which are summarized in the table. The major issues to be addressed concern the following inconsistencies, gaps and inaccuracies:

-The guidelines differ in their underlying philosophy and rationale. Some guidelines are based on background (or analytical detection) levels, others on "effects" levels, while some utilize a combination of these approaches. Although effects-based guidelines (e.g. Sediment Quality Guidelines) are generally more scientifically defensible, they require a large data base which is often unavailable.

-The potential for groundwater contamination has not been adequately addressed in the Decommissioning Guidelines. Consideration should be given to developing leachate criteria for this purpose.

-A question which hampers the formulation of guidelines for handling of excavated material in particular is the legal definition of "inert fill".

-Regulation 309 classifies waste on the basis of leachate concentrations only, and does not consider total ("bulk") concentrations. Consideration should be given to utilizing guideline numbers for both bulk and leachate levels in all disposal scenarios.

-There is a lack of consistency among the guidelines in the manner in which leachate tests are applied. Some guidelines specify the Regulation 309 acid leach procedure, others the distilled water leach procedure, while in some cases both procedures are utilized in the same set of guidelines.

-Although both the Dredged Material Guidelines and the Backfill and Construction Application Guidelines utilize Upper Limit of Normal (ULN) Guidelines (non-effects-based) to define disposal options, the guidelines contain several errors and inconsistencies, particularly in their use of

leachate quality criteria.

-The Foundry Sand Guidelines are the most recently-proposed MOE guidelines concerning disposal of material. They utilize the Soil Clean-up (Decommissioning) numbers for two broad land use categories (agricultural/residential/parkland and commercial/industrial), rather than the generally more stringent ULN Guidelines. Therefore, the Foundry Sand Guidelines propose to allow disposal on land of material which could contain "bulk" levels of contaminants only marginally below levels which would require clean-up according to the Decommissioning Guidelines.

-A limitation preventing the full application of existing guidelines is the lack of "numbers" for so many contaminants of potential concern. For example, of the 96 chemical/physical parameters for which an MOE number exists for at least one of the guidelines used to evaluate lakefill, only seven parameters have numbers in all six of the guidelines.

-The MOE is currently associated with two different sets of lakefill guidelines.

-The MOE Regions have encountered numerous situations requiring criteria for which there are no clearly defined Ministry guidelines available. The result has been that criteria have been applied which cannot be scientifically justified, and at times different criteria have been applied in similar situations.

-There is a need for clearly defined MOE guidelines for PCBs and PAHs in particular. Guidelines for these contaminants have been developed for the Canadian Council of Ministers of the Environment, but have not yet been formally adopted by Ontario.

Overall, the efforts of the MOE in developing guidelines to address specific situations are impressive and are recognized outside of the Ministry. Guidelines developed by Ontario are often appropriated by other jurisdictions, and MOE experts have played a central role in cooperative Federal-Provincial guideline setting exercises. However, because efforts within the Ministry have not been adequately coordinated, conflicts and inconsistencies have arisen both in methods of developing MOE guidelines and in the actual numbers.

The task which the Materials Policy Committee now must attempt is to utilize the best of what has been done to date and consider appropriate new approaches in order to develop a "grand policy" for handling and disposal of these materials that is comprehensive in scope yet simple to apply, and is a justifiable blend of pragmatism and science.

TABLE

SUMMARY OF MOE GUIDELINES/OBJECTIVES FOR SOILS, SEDIMENTS AND EXCAVATED MATERIAL

ideline or jective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
Sewage ludge ilization idelines	Promote environmentally safe and agriculturally beneficial use of a waste that would otherwise require incineration or landfill disposal. Soil contamination by metals and organics is main concern. Limits for metal levels in agricultural soils are based on multiples of background.	11 metals or metalloids. Intent to develop organics guidelines.	Tables 1,2.	1,2.	Approved by Cabinet. Revised guidelines took effect Jan. 86.	Soil metal guidelines should not be used as "effects levels".
uled wage Guidelines	Govern disposal of waste from cesspools, septic tanks, privy pits, chemical toilets, portable toilets and sewage holding tanks.	Guidelines are not contaminant specific.	N/A	8	"White Paper" identifying problems and proposing solutions is in preparation.	Should land disposal of untreated septage be allowed?
Compost uidelines	Guidelines developed by ad hoc committee accociated with Sludge and Waste Utilization Committee suggest limits for compost application on land in a manner similar to the Sewage Sludge Guidelines.	11 metals and metalloids	Similar to Table 1	10	The draft guidelines do not represent MOE's position. WMB is developing compost guidelines through a consultant.	WMB should work with Sludge and Waste Utilization Committee in finalizing guidelines.
Other rocessed astes	Provide information to assist regulators and users of processed wastes other than sewage sludge to decide if such wastes may be beneficially applied to agricultural land. Are very similar to Sewage Sludge Guidelines.	11 metals and metalloids	Identical to Table 1	12	Draft guidelines presently being finalized by Sludge and Waste Utilization Committee.	Land application of wastes that are not "processed organic wastes" is not addressed in Reg. 309.
Upper Limit f Normal" (ULN) Guidelines	Provide statistically-bound (99.7%) upper limit of background contaminant levels in urban and rural soils, as measured in MOE samples from non-point source contaminated sites. Exceedance of the levels is an indication of contamination. Toxic effects are not expected at levels lower than ULNs.	18 metals or inorganic chemicals	Table 3	13	Publ. as reference document Mar. 89. Do not apply to agricultural soils.	Should the ULNs become part of Reg. 308? There is now no formal review process for revision/ expansion.
Decommiss- ioning/ lean-up uidelines	Clean-up to background based on: a) sampling, b) ULNs or c) higher number consisting of either MOE clean-up number, clean-up number developed by other jurisdiction or clean-up number developed on site-specific basis. Main focus here is on MOE clean-up numbers, which were based on considerations of human health, animal health and phytotoxicity. Different numbers set for	13 metals or metalloids and 5 miscel- laneous parameters.	Tables 4,5	14,15	Adopted as MOE policy and published Feb. 89.	Groundwater contamination not evaluated. Thorough risk assessments not conducted. Should dilution be allowed? Need formal procedure for establishing guidelines for other

Guideline or Objective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	agricultural/residential/parkland and industrial/commercial land use.					contaminants (organics).
Regulation 309	Hazardous waste contaminants adopted from U.S. EPA system. Categorization of waste for disposal purposes based on leachate concentrations. Leachate criteria (Schedule 4) are multiples of Ontario Drinking Water Objectives for parameters related to health.	Schedule 4 includes 17 organics, 10 metals or metalloids and 4 miscellaneous parameters.	Table 6	1,6,22	"The law of the land." Most recent revision in 1985.	Need to clarify what qualifies as "inert fill" with Legal Services. Need policy to address disposal of material that leaches at <10 X Schedule 4 (non-registerable waste). Should "bulk" as well as leachate levels be used?
Open Water Disposal Guidelines	Guidelines were originally developed to provide protection of existing water uses from adverse effects of disposal of dredge spoils. Were modified from American sediment quality criteria.	11 metals and 7 miscellaneous parameters	Table 7	24	Developed by WRB in 1976. To be replaced by Sediment Quality Guidelines.	See p. 29. Need to inform users when officially replaced by SQG numbers.
Sediment Quality Guidelines	Biological effects-based guidelines for evaluation of sediments. Philosophy is protection for all water uses that is consistent with PWQOs. Three levels: a) no-effect, b) "lowest effect" (95% protected) and c) "limit of tolerance" (95% affected).	21 organics, 10 metals and 4 miscellaneous	Table 8	25	Draft guidelines are undergoing internal and external review.	Use min. 20 samples for background determinations, vs. 30 for ULNs. Should guideline numbers be refined on a regional basis?
Dredged Material Guidelines	Ensure management of dredged material is consistent with physical/chemical characteristics to protect environmental quality. Establish categories for following disposal options: a) Open Water Disposal, if meet Open Water Disposal Guidelines, b) Unrestricted Land Use, if meet Sludge Utilization Guidelines for max. permissible metal content in soil, c) Restricted Land Use (for disposal on commercial/industrial land), if meet ULN urban soil guidelines, and d) Waste, requiring disposal per Reg. 309.	13 metals and 7 miscellaneous	Table 9	26	Approved by Policy Committee but not by Minister's Office.	Inconsistencies between criteria in Table 9 and source documents. Should degree of enforcement vary depending on nature of contaminant? Need to modify when new SQGs are adopted for open water disposal. Should ULN Guidelines be used to classify waste for disposal?
Backfill and Construction Application Guidelines	Facilitate use of industrial waste so as to extend landfill life. Wastes will be studied for inclusion in "Schedule of Acceptable Wastes and Uses". Establish categories for following disposal options: a) Hazardous Waste, requiring disposal per Reg. 309, b) Lakefill/Shoreline Disposal, if meet Open Water Disposal Guidelines and Reg. 309 acid leach concentrations are < 10 X PWQOs, c)	16 metals and 10 miscellaneous	Tables 10, 11	27	Phase I draft report prepared for WMB by consultant. Phase II draft report describing field trial results is in preparation.	Inconsistencies between criteria in Table 11 and source documents. Propose disposal of registerable waste on land (incl.parkland). Use of registerable wastes in construction applications requires

uideline or ective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	Unrestricted Land Use, if both max. permissible metal content in sludged soil and rural soil ULN guidelines are met, and leach concentrations are < 10 X Reg. 309, d) Restricted Land Use, (for placement on commercial/industrial land and perhaps parkland) if urban soil ULNs are met and leach concentrations are < 100 X Reg. 309, e) Construction Use, if material is non-hazardous according to Reg. 309, and f) Immobilization (to reduce leachate concentrations) if bulk levels are acceptable.					full evaluation. Need for criteria for organics.
undry Sand Guidelines	To be used by MOE to determine acceptability of foundry sand in backfill and construction applications. Require proponent to submit comprehensive information concerning origin and proposed use of sand, and analytical data. Material classified as "waste" by Reg. 309 (i.e leach concentrations > 10 X Schedule 4) not eligible. Bulk concentrations must meet Clean-up Guidelines for particular land use. Organic scan also required. Distilled water leach tests required for comparison with criteria for placement at min. specified distances from surface water and wells. Leach criteria are multiples of Ontario Drinking Water Objectives.	Bulk criteria for 10 metals. Leachate criteria for 10 metals and 5 miscel-laneous.	Table 4 (bulk), Table 13 (leach)	30	Draft document being circulated within MOE for comment.	Should not disposal criteria be lower than clean-up criteria to allow a "margin for error"? Derivation of leachate criteria is not explained. Should distilled water leach test be used with Reg. 309? See Table 14 for inconsistencies among guidelines. Should criteria for distances from water be included in all guidelines governing land disposal?
9 Lakefill idelines	Employ bulk and leachate criteria to determine suitability for use as lakefill in the following manner: a) Restricted Fill (for placement within a securely-confining structure), if agricultural/residential/parkland clean-up guidelines for medium soils and Reg. 309 leach criteria (ODWOs) are met, b) Unrestricted Fill (suitable for open water disposal), if Open Water Disposal Guidelines are met, no "objectionable substances" are present and specified "receiving water simulation tests" (incl. < 10 X PWQOs/PWQGs in modified distilled water leach) are passed.	21 bioaccumu-lative organics. Other parameters as given in source guidelines.	Table 15	29	Approved by Policy Committee and Division Heads, but Management Committee instructed WRB to prepare a revised document describing all options, incl. MTRCA approach. This will be distributed for public comment.	Need for complete sets of guideline numbers for more contaminants. MOE (Central Region) also associated with MTRCA guidelines.
MTRCA Lakefill uidelines	Provide a consistent metro-wide guideline for assessment of fill quality. Classify fill as follows: a) eligible for open water disposal if Open Water Disposal Guidelines are met, b) eligible for "protected" or "confined" disposal if Dredged Material Restricted Land Use Guidelines are met, c) eligible for	ODWOs are listed for 17 parameters. Other parameters as given in source guidelines.	Table 15	19	Accepted by Minister for interim use at sites within jurisdiction of MTRCA.	Not desirable to have MOE associated with two sets of Lakefill Guidelines. Derivation of several numbers in Table 15 not as stated in document. Toronto Harbour

Guideline or Objective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	protected disposal if distilled water leach results meet ODWOs, and d) eligible for confined disposal if c) not met. Pre-disposal inspection Environmental Report required for "large sites". Material also to be visually inspected at lakefill location.					Commission no longer accepting material for lakefilling that does not meet current Open Water Disposal Guidelines. WRB and MTRCA Guidelines differ in definition of "restricted fill" and in testing requirements for open water disposal.
hell/Texaco lean-up Criteria for Trace rganics	Site-specific clean-up numbers were developed from determinations of "background" concentrations and "effects-based" concentrations in the following manner: a) background concentrations, determined from special sampling and analysis program, were multiplied by factors ranging from 10 to 80 to establish background-based trigger levels for clean-up, b) trigger levels were compared with health or phytotoxicity-based "acceptable concentration range" determined by consultants's risk assessment for residential land use, c) if consultant's value was less than trigger level, a clean-up level equal to consultant's value was set, d) background-based trigger levels were modified to recommended trigger levels where health-based levels had been set for similar compounds. Industrial/commercial levels set at twice residential levels. Exceedance of clean-up level requires clean-up; exceedance of trigger level requires further investigation.	44 organic compounds	Table 16	33, 34, 36	ICC awaiting approval of report by Senior Management. Guideline numbers are being used by Oakville MOE in Section 45 approval.	Restrictions imposed by analytical limitations for trace organics. Numbers not generally applicable to other sites, with the possible exception of the health-based clean-up numbers in other urban areas. ICC set commercial/industrial numbers at twice the residential numbers, although consultant recommended factors ranging from 6 to 100.
Lead in Soil Near Secondary Smelters	In recommending guidelines, Lead in Soil Committee reviewed the toxicology of lead, sources and pathways of lead in the environment, relationship between soil and blood lead, guidelines of other jurisdictions and recommendations of Royal Society and Board of Health.	Pb	Section 3.1.2.2 (p. 70)	37	Lead in Soil Committee report released by Minister in May 1987. Minister selected 500 ug/g as clean-up level.	Guidelines apply only to areas near secondary lead smelters. Scientific criteria document for lead nearing completion by Hazardous Contaminants Branch.
PCB Guidelines	Reg. 11/82 "PCB Waste" guideline of 50 ug/g was adopted from U.S. EPA. Interim PCB guidelines developed on behalf of Canadian Council of Ministers of the Environment (CCME) represent minimum clean-up levels and are based on standards in other jurisdictions and human health exposure modelling. They represent	PCBs (total)	Table 17	39	"PCB waste" criterion is law. Interim CCME guidelines have been adopted by CCME but not formally adopted by Ontario.	"PCB waste" criterion has no direct environmental or health basis. CCME clean-up level for home gardens is based on milk contamination of grazing animals.

Guideline or Objective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	"maximum acceptable concentrations" for the following land uses: a) agricultural (incl. home gardens) - limiting factor is contamination of milk; b) non-agricultural (residential or general public access) - based on exposure from air, water, soil and diet; c) commercial/industrial - based on worker and public exposure.					Should Ontario adopt guidelines more stringent than CCME (particularly for industrial/commercial land use)?
4B PAH Guidelines	WMB interim guidelines intended to ensure environmental and human health protection by providing guidelines for classification and disposal of PAH-contaminated waste material. Disposal otions are based on BaP (selected indicator) levels in leachate obtained using the Reg. 309 procedure. Leachate guidelines are based on WHO drinking water guideline for BaP.	BaP	Section 3.2.2.2 (p. 78)	42	Updated interim guidelines document circulated for comment by WMB.	Guidelines should stipulate that they are not intended to be used for clean-up. Are concentrations of BaP alone sufficient basis on which to classify waste for disposal?
CME PAH Guidelines	Interim guidelines promulgated on behalf of Canadian Council Of Ministers of the Environment are a modification of the "ABC" criteria used by Quebec (and adopted from the Dutch). This decision was made after an evaluation of existing guidelines on the basis of rationale, match with list of PAHs of concern (eight PAHs selected based on carcinogenicity and concentration in coal tar), and applicability to coal tar waste sites. Recommended use of ABC values is as follows: a) A Value - is approximate detection limit and should be used as investigative criteria for residential/agricultural land use; b) B Value - is intermediate (5 to 10 times higher than A) and should be used as remedial (clean-up) criteria for residential/agricultural land use and investigative criteria for commercial/industrial land use; c) C Value - represents significant contamination and should be used as remedial criteria for commercial/ industrial land use.	8 PAHs	Table 18	41	Interim guidelines have been adopted by CCME but not formally adopted by Ontario.	Guidelines not applicable to disposal of waste. Should guideline numbers be based on multiples of detection limits in absence of soil background concentrations and/or "effects" concentrations? Are guidelines applicable to other than coal tar sites? Are visual criteria sufficient for clean-up? Possible application of CCME groundwater guidelines as leachate criteria for waste disposal purposes.

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1.0 Introduction

1.1 Identification of Needs

Senior Management within the Ontario Ministry of the Environment (MOE) have identified two principal needs concerning the Ministry's policies and practices for the handling of sludges, soils or excavated material. The first of these is the need for a review of current practices. There exist within the Ministry of the Environment a number of different guidelines, objectives, etc. for sludges, soils and sediments that have been developed more or less independently by various Branches over the years. It is now recognized that there is a need to review the bases for these guidelines to ensure consistency both in the philosophy of environmental management and in the actual contaminant guideline numbers.

The second need that has been identified is that for a comprehensive MOE policy on clean-up, handling and disposal of sludges, soils and excavated material. In particular, there are no existing Ministry policies or guidelines to address the land disposal of materials, other than sewage sludge, which are neither hazardous waste nor waste subject to generator registration (registerable waste) under Regulation 309. It is intended that the formulators of this policy would carefully examine the information obtained through the review described above. The recommended policy would be submitted for approval by Senior Management and Policy Committee. The Policy would deal with the environmental management philosophy and also would contain guideline numbers for contaminants of concern.

1.2 Establishment of Committee

In May 1989, MOE Senior Management established a Materials Policy Committee (hereinafter referred to as the Committee) with representatives from the Hazardous Contaminants Coordination Branch, the Air Resources Branch, the Water Resources Branch, the Waste Management Branch and Central Region (see Appendix 1 for membership) to deal with the needs identified above.

1.3 Purpose of Report

The first task of the Committee is to produce a catalogue of existing MOE-utilized guidelines and policies related to sludge, soil and sediment. The present report is intended to fulfil this task. This report would then be utilized by the Committee in developing a comprehensive policy.

1.4 Outline of Report

General guidelines which have province-wide application are considered first in Section 2 of this report. Information is presented concerning existing or proposed (i.e. draft) MOE-utilized guidelines, objectives and practices governing the handling of sludges, soils and excavated material (including sediments), including their derivation and rationale, contaminants and guideline numbers, status, application, and limitations and precautions. Some MOE guidelines are essentially stand-alone guidelines which do not depend upon any other guidelines for their application. Other, generally more complex guidelines have been established which incorporate or make use of existing guidelines in their development and/or enforcement. For clarity of presentation, stand-alone guidelines will be dealt with before more complex guidelines.

Site-specific and/or contaminant-specific guidelines and practices are then dealt with in Section 3 of the report.

Specific Regional clean-up activities are summarized in Section 4.

Finally, Section 5 presents a guideline-by-guideline summary of the report in tabular form.

2.0 General Guidelines

2.1 Sludge Guidelines

2.1.1 Sewage Sludge Utilization Guidelines

2.1.1.1 Derivation and Rationale

Much of the summary information in this section is taken from ref. 1.

In 1970, a committee of Ontario engineers, soil, agricultural and environmental scientists and health specialists began studying the impact of sewage sludge application on agricultural lands. Interim guidelines were established in 1973. By 1974, a formal Ontario committee was formed, comprised of representatives from the Ontario Ministries of Health, Environment and Agriculture and Food, the Ontario Federation of Agriculture, the Municipal Engineers Association, the Association of Medical Officers of Health and the University of Guelph.

In 1978, a set of guidelines for sewage sludge utilization was published from the Committee's findings. Criteria for sludge application took into account the presence of metals or nutrients of concern or of benefit to agriculture, as well as public health considerations and environmental impacts. Limits on the concentrations of metals in both sludges and soil were established. Limits on the amount of nitrogen added to soil through sludge application (max. 135 kg ammonium plus nitrate nitrogen per hectare per five years), and minimum nitrogen to metal ratios in sludge, ensured that sludge application would have beneficial effects for agriculture.

The guidelines were revised in January, 1986 (ref. 2). Whereas the previous edition had defined limits on metal additions to soil due to sludge application based on mean metal concentrations of uncontaminated soil, this approach was revised to reflect the actual initial metal concentrations in soil. Other new inclusions were criteria for the acceptability of aerobic, dewatered and dried sludges. The rights and responsibilities of those involved in sludge application - sewage treatment plant operators, sludge haulers and farmers - were more fully defined. Also, separation distances, waiting periods and sludge blending criteria were revised.

Central to the sludge utilization guidelines, for both anaerobically-digested liquid sludge and aerobic and anaerobic solid sludge, is the establishment of maximum permissible metal additions (kg/ha) to Ontario agricultural

soils. These maximum permissible additions were calculated from the difference between the established maximum permissible metal content of sludged agricultural soils and the measured mean metal content of Ontario agricultural soils. The maximum permissible metal contents were determined by multiplying published mean values (ref. 3,4) by factors ranging from 2 to 8. The rationale for the selection of factors is outlined in Appendix II of ref. 2. Taken into consideration were toxicity (plants, animals and man), essentiality and deficiency.

The name of the Committee was changed in 1988 to the Sludge and Waste Utilization Committee to reflect increased responsibilities regarding application of other processed wastes to agricultural lands (see Section 2.1.2.3).

A "Research and Standards Subcommittee" has recently been established by the Sludge and Waste Utilization Committee to oversee the development of organic chemical guidelines for sludge utilization and to define research needed for the setting of such guidelines. Sludge guidelines for organic chemicals are needed for effective implementation of the MISA program. The subcommittee is recommending that the MOE fund a research program which has been proposed by scientists at the Environment Canada Wastewater Technology Centre in Burlington (ref. 5). Given the magnitude of the task, however, it is not possible to establish rigorous, experimentally-based organic chemical guidelines for sludge application within the one or two year time-frame required by MISA.

2.1.1.2 Parameters and Guideline Numbers

Table 1 gives criteria for 11 metals and metalloids for fluid anaerobically digested sewage sludge. Of main interest to the Materials Policy Committee are the figures in Column 3, which are Maximum Permissible Metal Contents in (Agricultural) Soil for 11 metals and metalloids. The sludge utilization program is designed to ensure that these metal levels are not exceeded in sludged soil.

Table 2 gives maximum permissible metal concentrations in aerobic sludge and dried and dewatered anaerobic sludge to be applied to land. It is apparent that far higher concentrations are permitted in the dried sludge than in the soil, reflecting the fact that the sludge is diluted by mixing with the soil plough layer.

2.1.1.3 Status

The original Guidelines for Sewage Sludge Utilization on Agricultural Lands, established in 1978, were approved for

TABLE 1

METAL CRITERIA FOR FLUID[a] ANAEROBICALLY DIGESTED SEWAGE SLUDGES

1 Metal	2 Mean Metal Content of Uncontaminated Ontario Soils ug/g)[b]	3 Maximum Permissible Metal Content in Soil (ug/g)[b]	4 Maximum Permissible Metal Addition to Soil kg/ha)[d]	5 Minimum Ammonium plus Nitrate Nitrogen (NH_4^+-N plus NO_3^--N) to metal Ratios Required in Sewage Sludge	6 Number of Years To Reach Maximum Recommended Metal Content in Soil (col. 3), Based on cols. 2, 3 and 5[c,d]	7 Minimum ammonium plus Nitrate Nitrogen (NH_4^+-N plus NO_3^--N) to Metals Ratios Required To Give Maximum Permissible Metal Content in Soil (col. 3) in 250 years[d]
ARSENIC	7	14	14	100	50	460
CADMIUM	0.8	1.6	1.6	500	30	4200
COBALT	5	20	30	50	55	220
CHROMIUM	15	120	210	6	45	32
COPPER	25	100	150	10	55	45
MERCURY	0.1	0.5	0.8	1500	45	8400
MOLYBDENUM	2	4	4	180	25	1700
NICKEL	16	32	32	40	45	210
LEAD	15	60	90	15	50	75
SELENIUM	0.4	1.6	2.4	500	45	2800
ZINC	55	220	330	4	50	20

a Dewatered and dried sludges are to meet the Column 5 criteria prior to dewatering and drying.
b Based on dry weight at 100°C.) The terms ug/g and mg/kg are interchangeable.
c Based on 135 kg. of ammonium plus nitrate nitrogen per hectare per five years and sewage sludge having minimum ratios. Number of years is rounded off to the nearest five years.
d Columns 4, 6 and 7 apply to soils of mean metal content (column 2) and require adjustment for soils lower or higher in metal content.

TABLE 2

METAL CRITERIA[a]
FOR ALL AEROBIC SEWAGE SLUDGES AND
FOR ALL DRIED AND DEWATERED ANAEROBIC SEWAGE SLUDGES

Metal	Maximum Permissible Metal Concentration (mg/kg of solids)[b]
Arsenic	170
Cadmium	34
Cobalt	340
Chromium	2800
Copper	1700
Mercury	11
Molybdenum	94
Nickel	420
Lead	1000
Selenium	34
Zinc	4200

a For permissible number of years to reach maximum metal concentrations in soils, refer to Table 1, column 6.

b Acceptability will be judged on the basis of the ratio of the average metal concentration during the preceding 12 months to the average concentration of solids during the same period or, at the discretion of local MOE staff and when solids and metals analyses are conducted once a month, on the basis of the last 3 results.

CALCULATIONS FOR AEROBIC SLUDGE USE ON LAND

1. To determine sludge acceptability, calculate 'Actual Metal Concentrations' and compare with the above Permissible Values

i.e. $\frac{\text{Metal Concentration (mg/l)} \times 10^6}{\text{Sludge Solids concentration (mg/l)}} = \frac{\text{mg of metal}}{\text{Kg of solids}}$

2. Calculate maximum application rate per 5 year period.

i.e. $\frac{8 \times 10^6}{\text{Sludge Solids (mg/l)}} = \frac{\text{Cubic Metres of Sludge}}{\text{Land Area in Hectares}}$

implementation by Cabinet in July, 1979. A phase-in period between 1979 and 1982 enabled municipalities with sludges not meeting criteria to improve those sludges or to develop acceptable disposal alternatives.

The revised guidelines took effect in January, 1986.

The Sludge Utilization Guidelines supplement Regulation 309 (see Section 2.3.1), but they are not a part of the Regulation.

2.1.1.4 Application

The sludge guidelines govern the application of municipal sewage sludge to agricultural land throughout the province. According to Regulation 309 (ref. 6), municipal sewage sludge is a "processed organic waste" and fields receiving sludge are "organic soil conditioning sites". As such, sludge application is subject to Part V of the Environmental Protection Act (ref. 7) and the Regulation. Additional control is maintained through requirements contained in Certificates of Approval.

The sludge guidelines do not apply to hauled sewage or "septage" (i.e. wastes removed from cesspools, septic tank systems, privy vaults, privy pits, chemical toilets, portable toilets and sewage holding tanks), to other unstabilized wastes or to other organic wastes including compost (see Section 2.1.2).

2.1.1.5 Limitations and Precautions

The "maximum permissible metal content in soil" for the 11 elements in Table 1 should be interpreted with caution. The selection of these numbers (obtained through multiplying published average metal levels in agricultural soil by a factor ranging from 2 through 8) was a largely arbitrary and highly conservative process. When compared with similar numbers used by other jurisdictions, Ontario's maxima are generally lower. These maxima were developed for reference to sludged agricultural soil, and were meant to ensure that sludge application (which is a purposeful process) did not result in any degree of soil contamination. They are conservative in that they are for the most part considerably lower than levels considered to have potential adverse effects. The latter are more reasonably represented by the clean-up levels for agricultural/residential/parkland use discussed in Section 2.2.2.

2.1.2 Other Organic Wastes

There exist a number of wastes which are similar to sewage sludge in that they are generally high in organic matter and are of potential benefit to agriculture. It is thus appropriate to consider these wastes in this section of the report. Included here are hauled sewage, compost and miscellaneous processed wastes. However, because the utilization or disposal of these wastes is not particularly germane to the task of this Committee, only a brief description of each will be presented here.

2.1.2.1 Hauled Sewage Guidelines

"Hauled Sewage" is defined in Regulation 309 as waste removed from a cesspool, septic tank system ("septage"), privy vault or pit, chemical toilet, portable toilet or sewage holding tank. Reg. 309 exempts hauled sewage from Part V of the Environmental Protection Act and the Regulation.

The management of hauled sewage falls under Part VII of the Environmental Protection Act, dealing with "Sewage Systems". Currently, the majority of hauled sewage, including non-stabilized raw material from holding tanks, is disposed of directly on land. Many authorities consider this to be an unacceptable practice because of the danger of pathogen contamination. The remainder is disposed of at sewage treatment plants, but not all such plants accept hauled sewage.

Procedures for disposal of hauled sewage on land are contained in the Manual of Policy, Procedures and Guidelines for On-site Sewage Disposal Systems (ref. 8). Chapter 13 of this manual applies to hauled sewage and class 7 sewage systems. Haulers must be licensed by the MOE, upon the recommendation of the local Health Unit, and Certificates of Approval are required for disposal sites. However, in view of the apparent inadequacies of the current legislation and procedures, Management Committee has called for the preparation of a "white paper", coordinated through Approvals Branch, which identifies septage problems and proposes solutions. This paper, which is to be released for public comment, recommends that the management of hauled sewage be transferred from Part VII to Part V of the Act and/or to Section 24 of the Ontario Water Resources Act. The paper also recommends that septage disposal on land not be permitted without pretreatment to reduce pathogens. Senior Management has already given approval in principle to this proposed policy change (ref. 9).

2.1.2.2 Compost Guidelines

"Composting" is defined in Reg. 309 as "the treatment of waste by aerobic decomposition of organic matter by bacterial action for the production of stabilized humus". Compost would, therefore, fall under the Reg. 309 definition of "processed organic waste", which is "waste that is predominantly organic in composition and has been treated by aerobic or anaerobic digestion, or other means of stabilization". Furthermore, composting sites are classified as waste disposal sites and are, therefore, subject to the requirements of Part V of the Environmental Protection Act and Reg. 309, including Certificates of Approval. Compost produced solely from agricultural wastes is, however, exempt.

An ad hoc committee produced "Draft Interim Guidelines for Compost Production, Quality and End Use" in 1982 (ref. 10). These guidelines suggest maximum compost application rates based on nutrient (nitrogen) and metal content, in a manner very similar to the Sewage Sludge Guidelines (Section 2.1.1). More recently, the Sludge and Waste Utilization Committee informed Waste Management Branch that it was prepared to finalize development of compost guidelines. However, WMB has chosen to award a contract for a literature review to a consultant (M. M. Dillon). This review covers process technology, application and siting guidelines world-wide, with an expected completion date of July 31, 1989. WMB hopes to then have draft compost application and siting guidelines prepared within six months. It has not been decided whether WMB will prepare their own guidelines or award another contract (ref. 11).

2.1.2.3 Other Processed Wastes

"Interim Guidelines for the Utilization of Processed Waste (Other Than Sewage Sludge) on Agricultural Lands" are currently being developed under the auspices of the Sludge and Waste Utilization Committee (ref. 12). These guidelines are intended to apply to materials, other than sewage sludge (or compost), which are defined as "processed organic waste" in Reg. 309. Being "waste", their use on land is subject to the requirements of the Environmental Protection Act and the Regulation. Furthermore, sites receiving such wastes would require certification as "organic soil conditioning sites". The guidelines, which are nearing completion, will provide information which will assist regulators and potential users of other wastes to decide if a particular waste may be beneficially applied to agricultural land. The guidelines discuss potential harmful constituents of wastes, including pathogens, metals, other elements and organic contaminants, as well as beneficial constituents such as organic matter,

nitrogen, phosphorus, potassium and other nutrients.

The processed waste guidelines are very similar to the Sewage Sludge Utilization Guidelines (Section 2.1.1) concerning suggestions for spreading site selection and handling, storage and spreading techniques. Maximum permissible metal concentrations in agricultural soil which receives processed waste are identical to those shown in Table 1 of this report.

Examples of the types of materials to which the guidelines might apply are (ref. 12):

- winery lees and grape residues
- dairy and egg processing wastes, including whey and buttermilk
- animal wastes and rendering residues, including blood, tissue, grease, feathers and hair
- selected (pre-tanning) tannery wastes
- food and canning industry process solids, such as molasses, fruit and vegetable pulps and solids.

One area of possible contention with the guidelines concerns the Reg. 309 definition of processed organic waste as waste that has been "stabilized" in some manner. There are a number of organic wastes of potential benefit to agriculture that should not require any sort of stabilization (e.g. food wastes). The status of such wastes does not appear to be clearly defined in the Regulation. There are also wastes of potential benefit to agriculture that are not "predominantly organic in composition" (e.g. ammonium nitrate from nuclear fuel processing) and, therefore, also may not be categorized as "processed organic waste". The use of these wastes on land is not addressed in Reg. 309.

2.2 Soil Guidelines

2.2.1 "Upper Limit of Normal" Guidelines

2.2.1.1 Derivation and Rationale

"Upper Limit of Normal" (ULN) guidelines for soil contaminants (and other terrestrial media) were developed by a Regulation 308 Working Group consisting of representatives from the Air Resources Branch and associates from NW and NE Regions in 1985. Separate soil guidelines were developed for urban (>10,000 population) and rural samples.

The ULN guidelines were statistically-derived by taking the mean of available analytical results (minimum of 30 data points required to assume approximation to normal distribution) for surface soil (0-5 cm depth) samples collected, mainly during complaint and assessment survey investigations, by MOE personnel from "background" (i.e. non point-source contaminated) sites in Ontario, and adding three standard deviations of the mean. Assuming the data are normally distributed, 99.7% of all contaminant concentration results for surface soil samples from background locations will lie below the ULN guidelines. For those distributions that are "non-normal", the calculated guidelines will not exactly correspond to the 99th percentile; however, they lie within the observed upper range of MOE results for background Ontario surface soil samples. Geometric means were not utilized because: 1) tests of representrative non-normal distributions showed that normality was not significantly improved by using log-transformed data, and 2) the guideline concentrations calculated from the geometric mean were higher than the maximum observed concentrations.

The Working Group selected the 99th percentile as the division between normal and elevated concentrations on the basis of calculated goodness-of-fit with pre-existing "Phytotoxicology excessive levels" (which were replaced by the ULNs) and because it was felt to be a reasonable approach that would provide a sufficient degree of environmental protection without causing undo concern.

2.2.1.2 Parameters and Guideline Numbers

The ULN guidelines for Ontario surface soil samples are shown in Table 3. Soil guidelines have been developed for 18 parameters, consisting of 17 metals or metalloids, plus sulphur.

TABLE 3

Contaminant Guidelines Representing Upper Limits of Normal Concentrations in Ontario Surface Soil.

Parameter	Urban[6]	Rural
Antimony	8	1[2]
Arsenic	20	10
Boron	15	10[2]
Cadmium	4	3,4[1]
Chromium	50	50
Cobalt	25[3]	25
Copper	100	60
Iron (%)	3.5[3]	3.5
Lead	500	150
Magnesium (%)	-	1
Manganese	700	700,1000[1]
Mercury	0.5	0.15
Molybdenum	3[5]	2[2]
Nickel	60[3]	60
Selenium	2	2
Sulphur (%)	-	0.1
Vanadium	70	70
Zinc	500	500

Notes:

[1] Where two values are shown, the first is based mainly on Southern Ontario data while the second is based on NE Region data.

[2] Provisional guideline estimated from range of results, pending additional data.

[3] Rural results higher than urban results - urban guideline based on rural results.

[4] For comparison with all of the above guidelines except sulphur, analyses should be conducted using an approved strong mixed-acid digestion procedure. For sulphur, analyses should be conducted using an approved combustion with either IR or titrimetric detection procedure. Contact Laboratory Services Branch of MOE for information on acceptable methods.

[5] All units are in ppm (µg/g), dry weight, unless otherwise stated.

[6] > 10,000 population.

2.2.1.3 Status

Consideration was given in 1985 to incorporating the ULN guidelines in Reg. 308 (Clean Air Program), but because they are subject to revision as new data are generated, the decision was made to simply publish them as a reference document. The guidelines were published in MOE Green Cover in March 1989 (ref. 13).

Recently, the suggestion that the ULN guidelines (if not for soil, at least for vegetation), or some modification thereof, be made a part of revised Reg. 308 has resurfaced. The opinion among ARB management is that the Minister's office would favour this approach because it would provide some useful regulatory numbers. A decision within ARB will have to be made shortly.

2.2.1.4 Application

The ULN guidelines are utilized by Phytotoxicology investigators in interpretation of contaminant levels in surface soil samples collected during complaint and assessment survey investigations. As described in Sections 2.3.4 and 2.3.5, they also have been incorporated in the proposed Dredged Material Guidelines and the Backfill and Construction Application Guidelines. The ULN guidelines do not represent maximum desirable or allowable levels of contaminants. Rather, they serve as levels which, if exceeded, would prompt further investigation on a case-by-case basis to determine the significance, if any, of the above-normal concentration(s). Concentrations which exceed the guidelines are not necessarily toxic to plants, animals or man. A literature review has shown that the guideline concentrations are generally within the ranges of results reported by other investigators.

2.2.1.5 Limitations and Precautions

Although there have been no instances identified to date where contaminant concentrations below the ULNs for urban and rural soil have been determined to be of concern, this remains a possibility because no formal health or environmental review of the guideline levels has been conducted.

Due to the large regional variability in soils across Ontario, control samples should always be collected in order to prevent erroneous conclusions regarding environmental contamination. This variability is reflected in the establishment of separate regional guidelines for some elements (Table 3).

The ULN soil guidelines are not necessarily applicable to agricultural situations, in that none of the samples were collected from cultivated land. Most agricultural soil samples are collected to a depth of 15 or 20 cm, as opposed to the 5 cm depth utilized for the ULN samples.

The ULN guidelines are subject to expansion and revision as more data become available. Although the original guidelines were established by committee, the committee has since been disbanded and there now is no formal mechanism in place to accomplish the revision process. A timetable for re-examination of the data base and revision of the guidelines (where justified) has not been established.

2.2.2 Decommissioning and Clean-up Guidelines

"Guidelines for the Decommissioning and Cleanup of Sites in Ontario" were published by Waste Management Branch in February, 1989 (ref. 14). The decommissioning guidelines state that, in principle, remedial action is required wherever contaminants are present at concentrations above ambient background levels. It is the responsibility of the proponent to determine the ambient background level of contaminants in local area soils. Where local background levels are themselves unacceptably elevated due to industrial or other activity, the "Upper Limit of Normal" Guidelines for soils previously described may be used to define background levels. Where ULN guidelines for contaminants of concern do not exist, a sampling program should be undertaken to determine background levels.

The Decommissioning Guidelines document states that clean-up levels above background may be developed provided that they are protective of health and the environment. The three general approaches that may be taken to develop such levels are:

1. application of relevant MOE policies and guideline numbers
2. application of appropriate clean-up criteria developed in other jurisdictions
3. development and application of site-specific clean-up levels.

In this section of the present report, attention will be focussed on approach no. 1, application of MOE guideline numbers. The Canadian Council of Ministers of the Environment (CCME) is pursuing the development of Federal decommissioning guidelines through a consultant, but these have not yet been distributed for review (see Section 2.2.2.3). Development of site and parameter-specific levels in Ontario will be addressed in Section 3 of this report. Where the MOE Regions have used different criteria for clean-up, these will be identified in Section 4 of the report.

2.2.2.1 Derivation and Rationale (MOE Guideline Numbers)

The history and rationale for development of the MOE soil clean-up numbers are described in detail in ref. 15. The following is a summary of the main aspects.

MOE soil clean-up guideline numbers for inclusion in the Decommissioning Guidelines were recommended by the Phytotoxicology Section of Air Resources Branch, with major

development input from Monenco Consultants, the Ministry of Labour (re health effects) and the OMAF/MOE/MOH Sludge and Waste Utilization Committee. Initiation of guideline development occurred in 1984 at the request of the Halton-Peel District MOE, who approached the Phytotoxicology Section with a request for acceptable soil levels of contaminants associated with refinery lands being decommissioned. An ad hoc committee of representatives from the District MOE, the Waste Management Branch, the Ministry of Labour and the Phytotoxicology Section was formed to consider recommendations put forth by the proponents and their consultants. One of the recommendations made was that considerations of proposed land use made it desirable to have separate criteria for residential and industrial redevelopment. This position was accepted by the ad hoc committee, given that it was not inconsistent with that adopted by other jurisdictions (e.g. Great Britain).

The clean-up levels were based upon considerations of human health, animal health and phytotoxic effects, as reported in the literature or revealed by MOE investigations. Guidelines utilized by other jurisdictions were examined, and background concentrations of contaminants also were considered (the largest factor by which a clean-up number exceeds an Upper Limit of Normal guideline is 20, which was judged to be an acceptably low factor). In general, clean-up levels were first established which were considered sufficiently low to prevent adverse effects to the most sensitive receptor, be it plants, animals and man, in a residential or parkland use situation. Different industrial/commercial clean-up levels (normally set, somewhat arbitrarily, at twice the residential levels) were recommended where the principal concerns (i.e. phytotoxicity or human health) were similar, but where the degree of risk was judged to be significantly less in the industrial than in the residential situation.

For a few contaminants for which knowledge of potential adverse effects was more limited, provisional clean-up guidelines were established.

More recently, the Phytotoxicology Section was requested by the Waste Management Branch to develop clean-up levels for agricultural land use. This request was brought to the attention of the Sludge and Waste Utilization Committee. In the opinion of this committee, the residential/parkland clean-up levels previously recommended were, with minor modifications/qualifications, also suitable for application to agricultural situations.

The development of the original clean-up numbers utilized data from studies with medium to fine textured soils, in

which mobility and availability of metals would be lower than in coarse textured (sandy) soils. Therefore, separate clean-up guideline categories were established for coarse textured mineral soils (i.e. >70% sand and <17% organic matter). In consultation with the Sludge and Waste Utilization Committee, the coarse textured soil guidelines for the metals and metalloids were set equal to approximately 75% of the medium/fine textured soil guidelines. Exceptions were molybdenum and selenium, where the numbers remained the same in order to avoid conflict with the Sludge Utilization Guidelines (see Section 2.1.1).

The recommended clean-up numbers are not the product of an entirely rigorous and consistent scientific approach but rather represent the best judgment of those environmental and health experts who were consulted. Levels of contaminants that have been observed to have or are suspected of having undesirable effects on plants, animals or man were the main basis for the numbers. By the manner in which they were derived, the clean-up numbers can be roughly compared with the "lowest effect level guidelines" proposed in the WRB Sediment Quality Guidelines (Section 2.3.3), but data were not available to enable the same degree of statistical validity.

2.2.2.2 Parameters and Guideline Numbers

MOE's Clean-up Guidelines and Provisional Clean-up Guidelines for soils are shown in Tables 4 and 5. Clean-up Guidelines have been established for 18 parameters, including 13 metals or metalloids, pH, electrical conductivity, sodium adsorption ratio, nitrogen and oil and grease. Provisional Clean-up Guidelines currently exist for four contaminants. The two broad land use categories are agricultural/residential/parkland and commercial/industrial. Within these broad categories there are further divisions according to soil type as described above.

2.2.2.3 Status

The Clean-up Guidelines and Provisional Clean-up Guidelines were published in February 1989 in the previously-mentioned White Cover report entitled, "Guidelines for the Decommissioning and Cleanup of Sites in Ontario" (ref. 14). These Decommissioning Guidelines are an official MOE policy document. They were promulgated by Waste Management Branch, and are the product of deliberations of the MOE Decommissioning Guidelines Committee which consisted of representatives from several MOE branches and Central Region. The clean-up numbers have been utilized in numerous decommissionings and site clean-ups in the province (see Section 4).

TABLE 4

CLEAN-UP GUIDELINES FOR SOILS

Parameter[2]	Criteria for Proposed Land Use[1,3]			
	Agricultural/Residential/ Parkland[4]		Commercial/Industrial	
	Medium & Fine Textured Soils	Course Textured Soils[5]	Medium & Fine Textured Soils	Course Textured Soils[5]
pH (recommended range)	6-8	6-8	6-8	6-8
EC (mS/cm)[7]	2	2	4	4
SAR[8]	5	5	12	12
Arsenic	25	20	50	40
Cadmium	4[1a]	3[1a]	8[1a]	6[1a]
Chromium (VI)	10	8	10	8
Chromium (total)	1000	750	1000	750
Cobalt	50	40	100	80
Copper	200[1b]	150[1b]	300	225
Lead	500[1a]	375[1a]	1000[1a]	750[1a]
Mercury	1[1a]	0.8[1a]	2[1a]	1.5[1a]
Molybdenum	5[1b]	5[1b]	40	40
Nickel	200	150	200	150
Nitrogen (%)	0.5[9]	0.5[9]	0.6[9]	0.6[9]
Oil and Grease (%)	1[6]	1[6]	1[6]	1[6]
Selenium	2[1b]	2[1b]	10	10
Silver	25	20	50	40
Zinc	800	600	800	600

Notes:

1 Clean-up guidelines recommended by the Phytotoxicology Section, Air Resources Branch, Ministry of the Environment. The guidelines are based primarily on phytotoxicity except for ([1a]) based on human health, and ([1b]) based on health of grazing animals.

2 All units are in ppm (µg/g), dry weight, unless otherwise stated.

3 For comparison with these guidelines, analyses for metal and metalloids must be conducted using an approved strong, mixed-acid digestion procedure. Contact the Laboratory Services Branch of MOE if in doubt about acceptable methods.

4 Guidelines have been endorsed by the OMAF/MOE/MOH Sludge Utilization Committee.

5 Defined as greater than 70% sand and less than 17% organic matter.

6 Guideline given is for fresh oil; for weathered oil (min. 2 yr. exposed on site), the guideline is 2%.

7 EC = electrical conductivity (saturation extract).

8 SAR = sodium adsorption ratio.

9 If nitrogen levels exceed the guidelines, the mineralization of the soils should be evaluated. Additions of nitrogen-based fertilizer may be counter-productive.

TABLE 5

PROVISIONAL CLEAN-UP GUIDELINES FOR SOILS

Parameter[2]	Criteria for Proposed Land Use[1/3/4]			
	Agricultural/Residential/ Parkland		Commercial/Industrial	
	Medium & Fine Textured Soils	Course Textured Soils[5]	Medium & Fine Textured Soils	Course Textured Soils[5]
Antimony	25	20	50	40
Barium	1000	750	2000	1500
Beryllium	5	4	10	8
Vanadium	250	200	250	200

Notes:

[1] These guidelines are tentative: actual permissible levels of parameters in other situations may vary according to site-specific circumstances. Further information on the application of these guidelines may be obtained from the Phytotoxicology Section of Air Resources Branch, Ministry of the Environment.

[2] All units in ppm (µg/g), dry weight.

[3] For comparison with these guidelines, analyses must be conducted using an approved strong, mixed-acid digestion procedure. Contact the Laboratory Services Branch of MOE if in doubt about acceptable method.

[4] These provisional guidelines apply to soil of minimum pH 6.

[5] Defined as greater than 70% sand and less than 17% organic matter.

The Canadian Council of Ministers of the Environment (CCME) has established a Federal/Provincial Decommissioning Guidelines Committee which is currently developing, through Monenco Consultants, a risk-assessment based methodology for identifying site-specific clean-up criteria, which will be intended for application to those contaminants for which there are no existing guidelines. In general, however, the CCME Decommissioning Guidelines will be consistent with the approach adopted by Ontario (ref. 16).

2.2.2.4 Application

As described above, the Phytotoxicology Section recommended soil Clean-up Guidelines were originally developed for the decommissioning of oil refinery lands in Halton-Peel Region, but have been modified and adopted as province-wide clean-up levels. They are considered to be suitable for direct application in the majority of site clean-up scenarios that may be encountered in Ontario. Since they are considered to be primarily "effects-based" guidelines, they can, if judiciously applied, be used to determine if sites other than those specifically slated for decommissioning contain "undesirable" levels of contaminants.

As described in ref. 14, it is the responsibility of the proponent of a decommissioning to arrange for testing to determine the concentrations of contaminants on the subject lands. Suggestions regarding sampling techniques are given in ref. 15 and in the Phytotoxicology Section "Field Investigation Manual" (ref. 17).

The Decommissioning Guidelines state that the proponent must work closely with the MOE, because site-specific decisions regarding requirements for analyses and degree of clean-up are necessary in most decommissionings. Presumably, final decisions on clean-up requirements would be made by Regional MOE staff, who may wish to consult with other authorities (e.g. Waste Management Branch, Hazardous Contaminants Coordination Branch, Phytotoxicology Section).

2.2.2.5 Limitations and Precautions

The clean-up numbers are based on information available at the time they were developed. In future, new infomation may come to light which would justify a revision to the clean-up guidelines. In view of this possibility, the Decommissioning Guidelines document expressly states that the MOE will not accept any responsibility for future environmental concerns that may arise at a site that had previously been cleaned up to the MOE's then-current requirements.

Although the clean-up numbers have been recommended for general application in Ontario, different criteria should be applied if justified by site-specific considerations (discussed in ref. 14). As indicated in a note to Table 5, it is suggested that involved parties contact the Phytotoxicology Section for ad hoc technical advice concerning site-specific applications.

The health-based clean-up numbers (Hg, Pb, Cd) were developed based on the risks of ingestion, as proposed by Monenco Consultants, and were reviewed by the Ministry of Labour and by the Medical Officer of Health for Kingston (for application to a local clean-up). However, no thorough risk assessment (other than that for lead discussed in Section 3.1.2) has been conducted to verify the appropriateness of the numbers.

A gap that exists in the current decommissioning numbers concerns contaminant levels that pose a potential threat to groundwater quality. Ref. 14 states that this factor needs to be evaluated on a case-by-case basis, but there is no formalized procedure for this evaluation.

Although exceedances of the clean-up numbers may indicate the presence of undesirable contamination, it is not the intent of the guidelines to suggest that amelioration is required when such exceedances occur outside of the context of a decommissioning, and they should not of themselves be used to justify such action.

The Phytotoxicology Section has proposed certain requirements regarding depth of clean-up and allowable ameliorative techniques, including on-site dilution for those "contaminants" that are essential nutrients (ref. 18), but has encountered opposition to these proposals within Waste Management Branch. There is a need for further policy development in these areas.

The Decommissioning Guidelines document states that clean-up numbers for additional parameters, including organics, will be added to Tables 4 and 5 as they are developed or adopted for use in Ontario. There is a need for a formal procedure to accomplish this task. Development of scientifically-sound clean-up guidelines for organics, in particular, requires a thorough evaluation of all processes affecting contaminant concentration and movement, including volatilization, degradation, plant uptake and leaching.

The Decommissioning Guidelines place great emphasis on "background" concentrations of contaminants in setting clean-up numbers. Sampling and analyses are required to obtain this information (see Section 3.1.1).

2.3 Excavated Material Guidelines

2.3.1 Regulation 309

2.3.1.1 Derivation and Rationale

Much of the information in this section is taken from ref. 1.

Regulation 309 falls under Part V of the Environmental Protection Act which deals with Waste Management. The most recent amendments to Reg. 309 occurred in 1985 (ref. 6). These amendments provided a more specific definition of hazardous and liquid industrial wastes, increased responsibilities for generators, carriers and receivers of waste, and an expanded manifest system for the "cradle to grave" tracking of wastes.

Reg. 309 classifies waste according to type of waste and degree of hazard. Candidate substances for listing as Hazardous Wastes (of which there are eleven classes defined in the Regulation) were chosen from the U.S. EPA Hazardous Waste Management System, Appendix 8 of "Identification and Listing of Hazardous Waste". In future, substances for listing will also be identified through reviews of wastes of concern to the MOE, the public, industry, unions or other agencies.

In Ontario, wastes or their constituents are considered a potential hazard if:

1. They are inherently capable of migrating from the matrix of the waste in a concentration sufficient to cause substantial hazard.
2. Their mismanagement could lead to environmental release of the migrating waste constituents.
3. They are mobile and persistent enough to leach to environmental receptors and cause substantial hazard upon environmental release.
4. They possess characteristics of ignitability, reactivity, corrosivity, pathogenicity or toxicity.

Schedule 1 of Regulation 309 lists Hazardous Industrial Wastes from non-specific and specific sources, and is based on constituents of the waste having demonstrated hazardous characteristics. Schedule 2, Part A lists Acute Hazardous Waste Chemicals that have been found to be fatal to humans or other mammals in low doses, or are otherwise capable of causing or significantly contributing to an increase in serious irreversible or incapacitating reversible illness. Schedule 2, Part B lists Hazardous Waste Chemicals that studies have shown to have toxic carcinogenic, mutagenic or

teratogenic effects on humans or other life forms. Schedule 3 is a list of seven Severely Toxic Contaminants (aflatoxin, five dioxin congeners and one furan congener) of major concern such that if present in a waste at a concentration greater than 1 ppm, the waste would be considered hazardous. The chemical lists in Schedules 1, 2 and 3 are derived from the U.S. EPA system.

Schedule 4 (Leachate Quality Criteria) of Regulation 309 is of direct relevance to the issue of disposal of excavated material. This schedule lists contaminants that, should they leach (using the acid Leachate Extraction Procedure described in the Regulation) from excavated material (or any other waste) at concentrations greater than 100 times the concentrations shown [which represent Ontario Drinking Water Objectives for parameters related to health (see Section 2.3.1.2)], the excavated material would be considered hazardous (Leachate Toxic Waste). Such wastes must be disposed of at a hazardous waste facility. Excavated material that contains contaminants that leach at concentrations between 10 and 100 times the levels shown in Schedule 4 is, according to Regulation 309, subject to generator registration and may, therefore, be termed Registerable Solid Waste (ref. 19). Such wastes are not hazardous wastes but would require disposal at a registered non-hazardous disposal facility.

If it does not qualify as "Inert Fill" (see below), excavated material that contains contaminants that leach at concentrations less than 10 times the levels in Schedule 4 has been termed Non-registerable Solid Waste in ref.19 (Section 2.3.7), by virtue of being excluded from the above categories. However, it is important to note that this definition does not appear in Reg. 309, and in fact the Regulation does not clearly define the status of such material. If it is indeed "waste", it would be subject to all requirements of Part V of the Act (i.e. Certificates of Approval, etc.) (see Section 2.3.1.5).

Excavated material that consists of "earth or rock fill or waste of similar nature that contains no putrescible materials or soluble or decomposable chemical substances" is defined as Inert Fill by Regulation 309. Inert fill is exempted from the requirements of Part V and Reg. 309.

2.3.1.2 Parameters and Guideline Numbers

Table 6 reproduces Schedule 4 of Regulation 309. Leachate Quality Criteria are given for 31 contaminants, including 17 organics, 10 metals or metalloids and 4 miscellaneous substances. The criteria represent Ontario Drinking Water Objectives for parameters related to health. The derivation

REG. 309 LEACHATE QUALITY CRITERIA

Reference Number	Contaminant	Concentration (milligrams per litre)
ON4001	2,4,5-TP / Silvex / 2-(2,4,5-Trichlorophenoxy) propionic acid	0.01
ON4002	2,4-D	0.1
ON4003	Aldrin + Dieldrin	0.0007
ON4004	Arsenic	0.05
ON4005	Barium	1.0
ON4006	Boron	5.0
ON4007	Cadmium	0.005
ON4008	Carbaryl / 1-Naphthyl-N-methyl carbamate / Sevin	0.07
ON4009	Chlordane	0.007
ON4010	Chromium	0.05
ON4011	Cyanide (free)	0.2
ON4012	DDT	0.03
ON4013	Diazinon / Phosporidithioic acid, O,O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) ester	0.0002
ON4014	Endrin	0.0002
ON4015	Fluoride	2.4
ON4016	Heptachlor + Heptachlor epoxide	0.003
ON4017	Lead	0.05
ON4018	Lindane	0.004
ON4019	Mercury	0.001
ON4020	Methoxychlor / 1,1,1-Trichloro-2, 2-bis(p-methoxyphenyl)ethane	0.1
ON4021	Methyl Parathion	0.007
ON4022	Nitrate + Nitrite	10.0
ON4023	Nitrilotriacetic acid	0.05
ON4024	Nitrite	1.0
ON4025	PCBs	0.003
ON4026	Parathion	0.035
ON4027	Selenium	0.01
ON4028	Silver	0.05
ON4029	Toxaphene	0.005
ON4030	Trihalomethanes	0.35
ON4031	Uranium	0.02

and rationale for the latter are discussed in ref. 20 and 21.

2.3.1.3 Status

Regulation 309, falling as it does under the Environmental Protection Act, is of course, law.

2.3.1.4 Application

Regulation 309 governs the management of waste throughout Ontario, including transport of waste within, out of, into and through Ontario. The Ontario Ministry of the Environment is responsible for the administration and enforcement of the Regulation.

2.3.1.5 Limitations and Precautions

"Waste" is defined in Part V of the Environmental Protection Act as including "ashes, garbage, refuse, domestic waste, industrial waste, or municipal refuse and such other wastes as are designated in the regulations". Regulation 309 designates the following materials as wastes:

1. Dust Suppressant
2. Inert Fill
3. Processed Organic Waste
4. Recyclable Material
5. Rock Fill or Mill Tailings from a Mine
6. Waste-derived Fuel
7. Hazardous Waste
8. Hauled Liquid Industrial Waste

The Regulation then proceeds to exempt several wastes from Part V of the Act and the Regulation, including Inert Fill.

Of concern to the problem of disposal of excavated material is the definition of Hazardous Waste. As indicated in Section 2.3.1.1, there are eleven categories of Hazardous Waste listed in the Regulation, one of which is Leachate Toxic Waste. As described previously, this is waste that leaches at concentrations greater than 100 times the Schedule 4 Leachate Quality Criteria (Drinking Water Objectives). Other Hazardous Wastes as defined in the Regulation (e.g. Corrosive Waste, Reactive Waste, PCB Waste) would seldom be of concern with excavated material.

For the purposes of Generator Registration, waste that leaches at at concentration between 10 and 100 times the Schedule 4 criteria is defined as "subject waste", and although not considered hazardous, such wastes also must be registered and disposed of only at approved sites.

The above summarizes the definitions of waste contained in Part V and Regulation 309. There is nothing said about materials that leach at concentrations less than 10 times the Schedule 4 criteria, other than for what is defined as Inert Fill. The definition of inert fill (Section 2.3.1.1), which is called a waste but is then exempted from Part V and the Regulation, is so restrictive that little if any excavated material would qualify in any event. However, since inert fill is a waste, then presumably material that exhibits any leachability whatsoever would also be a waste and would therefore be subject to the legal requirements. This is apparently the opinion of our Legal Services Branch (ref. 22), but this issue requires clarification.

According to ref. 22, most excavated material in the province would presently be classified by Waste Management Branch as "inert fill", and would thus be exempt from the legal requirements for disposal of waste. However, according to the definition in Regulation 309, it is difficult to see how the majority of excavated material could be so classified. Most excavated material would probably fall in the "grey area" between inert fill and registerable solid waste.

One of the principal tasks of the Materials Policy Committee is to recommend a policy for the handling of material that falls into this grey area. The Waste Management Branch has already made initial proposals toward this goal (ref. 22). Their suggested categorization considers leach characteristics (the principal thrust of Reg. 309) as well as total (bulk) concentrations of contaminants. The latter would seem to be a wise inclusion, since many existing guidelines (e.g. soil Clean-up Guidelines) are based on total contaminant levels which consider other environmental effects (e.g. phytotoxicity) in addition to human health. The exclusion of considerations of total contaminant levels (with the exception of a few toxic organic contaminants) and of other environmental effects are perhaps weaknesses in the Regulation. Certainly, one must conclude that developers of policies and guidelines should not rely solely on the Schedule 4 (i.e. drinking water-based) criteria to determine if materials are environmentally innocuous, because other receptors may be more sensitive [e.g. the drinking water guidelines for boron and fluoride (5 and 2.4 mg/l, respectively) significantly exceed MOE's recommended maximum concentrations for irrigation water (0.75 and 1 mg/l, respectively) (ref. 23)].

2.3.2 Open Water Disposal Guidelines

2.3.2.1 Derivation and Rationale

Guidelines for open water disposal of dredge spoils were developed in 1976 by the Water Resources Branch (ref. 24). Provided that existing water uses will not be affected, the MOE will allow open water disposal of dredge spoils that meet the guidelines.

The guidelines were modified from existing American criteria for sediment quality which were intended to be based on an association of elevated levels of contaminants in sediments with impaired water quality and/or the presence/absence of benthic indicator species (see, however, Section 2.3.2.5). In the case of mercury and PCB, the guidelines were based on an apparent correlation of sediment levels with levels in fish exceeding the human consumption guidelines.

2.3.2.2 Parameters and Guideline Numbers

The Open Water Disposal Guidelines are shown in Table 7. Guideline numbers exist for 11 metals and seven additional parameters, including oil and grease, cyanide and PCBs.

2.3.2.3 Status

Ontario's guidelines for open water disposal of dredged sediments were published in 1976 in an MOE Green Cover document entitled "Evaluating Construction Activities Impacting on Water Resources" (ref. 24).

New "Provincial Sediment Quality Guidelines" have recently been drafted (Section 2.3.3), which are intended to supersede the Open Water Disposal Guidelines if and when the former are approved by Policy Committee.

2.3.2.4 Application

Sediments for which concentrations of one or more contaminants exceed the Open Water Disposal Guidelines are considered to be contaminated. However, the authors of the guidelines state that each situation should be considered on a case-by-case basis and some flexibility should be allowed according to local conditions and the nature of the project.

Dredged spoils that exceed the guidelines for any parameter and as a result are considered unsuitable for open water disposal must, according to the guidelines, be confined within dyked areas or disposed of upland so as to prevent entry to a water-course.

TABLE 7

OPEN WATER DISPOSAL GUIDELINES*

PARAMETER	OPEN WATER DISPOSAL GUIDELINES All units in µg/g, dry weight, unless otherwise specified.
VOLATILE SOLIDS (Loss on ignition at 600°C)	6%
TOTAL KJELDAHL NITROGEN	0.2%
TOTAL PHOSPHORUS	0.1%
OIL AND GREASE	0.15%
PCBs	0.05
MERCURY	0.3
LEAD	50.0
ZINC	100.0
IRON	10,000.0
CHROMIUM	25.0
COPPER	25.0
ARSENIC	8.0
CADMIUM	1.0
CYANIDE	0.1
AMMONIA	100.0
NICKEL	25.0
COBALT	50.0
SILVER	0.5

* Persaud, D., and Wilkins, Evaluating Construction Activities Impacting on Water Resources. MOE, 1976.

NOTES:

The Open Water Disposal Guidelines included parameters for eleven heavy metals, nutrients, PCBs, cyanide, and oil and grease.

Over the last 5 years, the Ministry's In-Place Pollutants Program has been obtaining information that will provide a better understanding of the biological significance of contaminants in sediment. This information, together with related information from other sources, e.g., USEPA, are currently being used by the Ministry in developing Provincial Sediment Quality Guidelines. Until these Guidelines are available sometime in 1989, the Open Water Disposal Guidelines for Dredged Material are being used to determine whether material is suitable for open water disposal.

2.3.2.5 Limitations and Precautions

Limitations which the authors have identified to prevent application of these guidelines as absolute criteria are:

1. They are based on bulk sediment analysis, and differences in substrate type (e.g. silt vs. sand) may dramatically affect contaminant concentration even where contaminant inputs are similar.
2. The individual parameter levels were for the most part empirically derived and relate mainly to some incremental change above "background" rather than to known "effects levels".
3. Synergistic effects are not adequately understood.
4. Individual parameter levels may be exceeded under natural conditions. Local background conditions should be taken into account in application of the guidelines.
5. The chemistry of bioaccumulation of trace contaminants is poorly understood, and factors influencing rates of uptake by aquatic organisms have not yet been quantified.

2.3.3 Sediment Quality Guidelines

2.3.3.1 Derivation and Rationale

Provincial Sediment Quality Guidelines (SQGs) have recently been drafted by the Aquatic Biology Section of Water Resources Branch (ref. 25). They arose from a recognized need for biological effects-based guidelines for the evaluation of sediment. The guidelines are intended to provide a level of protection for aquatic organisms and for other water resources and uses that is consistent with Ministry goals with respect to other objectives such as Provincial Water Quality Objectives (PWQOs).

Data from the MOE's In-place Pollutants Program and from other sources (e.g. U.S. EPA) were utilized to develop sediment guidelines in a management framework that could be used to establish discharge limits and effective remedial action (see "Application" below). To this end, the following three levels of sediment contamination guidelines were recommended:

1. A No-effect Level which will protect all biological resources, as well as the quality and use of water for all other purposes.
2. A Lowest Effect Level which can be tolerated by the majority (i.e. 95%) of benthic organisms.
3. A Limit of Tolerance Level which would be detrimental to the majority (i.e. 95%) of benthic organisms.

The rationale and methodology behind the development of these three levels of guidelines is complex and will only be summarized in the present document. The reader is referred to ref. 25 for more detailed information (note that the May 1989 draft of these guidelines contains several inconsistencies which are to be corrected).

No-effect Level Guidelines - No-effect levels for non-polar organics were obtained through a chemical equilibrium partitioning approach using PWQOs or tissue criteria. Exceptions were aldrin and HCB, where calculated no-effect levels were higher than observed lowest effect levels. For these compounds, and for other organics for which PWQOs or tissue criteria have not been established, background values were used. For metals, an "effects-based value" was calculated which was derived from a Screening Level Concentration (SLC) Approach (utilizing the 5th percentile of the frequency distribution of contaminants vs. benthic species). The lower of this SLC value and the background concentration was utilized as the no-effects level. This approach would also apply to polar organics, although no polar organics guidelines have yet been set. Other effects-based approaches (i.e. Apparent Effects Threshold Approach and Spiked Bioassay Approach) were considered but were ruled out for the present due to a paucity of data.

Lowest Effect Level Guidelines - For metals and nutrients, the higher of the 5th percentile SLC value (described above) and the background concentration (average of minimum 20 samples) was used as the Lowest Effect Level. For the non-polar organics, the 5th percentile SLC value was utilized, which was normalized to 1% total organic carbon (TOC).

Limit of Tolerance Level Guidelines - For metals and nutrients, the 95th percentile of the SLC distribution was used. For the non-polar organics, a 95th percentile SLC value was also calculated, which must then be normalized for actual sediment TOC content (to a maximum of 10%).

2.3.3.2 Parameters and Guideline Numbers

Sediment Quality Guidelines (also referred to as Sediment Management Guidelines) have been recommended for 10 metals, 21 non-polar organic compounds or groups of compounds, and four additional parameters (nutrients and oil and grease). The guidelines are shown in Table 8.

2.3.3.3 Status

The Provincial Sediment Quality Guidelines are in draft form and are presently undergoing internal MOE review. They also have been sent to Environment Canada for review and comment.

TABLE 8

Sediment Management Guidelines (All values in µg/g unless stated otherwise)

METALS	No Effect Level	Lowest Effect Level	Limit of Tolerance Level
As	4.0	5.5	33.0
Cd	0.6	1.0	10.0
Cr	22.0	31.0	111.0
Cu	15.0	25.0	114.0
Fe %	2.0	3.0	4.0
Pb	23.0	31.0	250.0
Mn	400.0	457.0	1100.0
Hg	0.1	0.12	2.0
Ni	15.0	31.0	90.0
Zn	65.0	110.0	800.0
ORGANICS			µg Contam./g Carbon (TOC)*
g-Chlordane	0.001	0.005	6.6
Heptachlor	0.001	0.002	0.5
Endrin	0.002	0.003	33.1
Mirex	0.001	0.007	128.4
Aldrin	0.001	0.002	9.1
Chlordane	0.0002	0.008	6.18
pp-DDT	0.0001	0.009	13.6
pp-DDD	0.002	0.008	9.0
pp-DDE	0.003	0.005	21.3
op-DDT	0.001	0.006	11.3
PCB 1254	-	0.058	34.4
PCB 1248	-	0.034	150.5
PCB 1016	-	0.007	53.3
PCB (Total)	0.01	0.041	69.8
Dieldrin	0.006	0.019	59.0
BHC	-	0.003	11.8
g-BHC	0.002	0.003	25.0
b-BHC	0.001	0.005	21.0
a-BHC	0.001	0.006	10.4
HCB	0.001	0.020	47.6
Heptachlor Epoxide	0.001	0.005	5.5
NUTRIENTS			
TOC %		1.0	10.0
TKN		545.0	4800.0
T.P.		600.0	2050.0
Solvent Extractables (Oils and greases)		2400.0	-

* Values in this column are multiplied by the actual TOC content of the sediments e.g. @ TOC of 5%, PCB value is 70 x 0.5 or 3.5 ppm.

Upon receipt of comments from concerned parties, it is the intention of Water Resources Branch to produce an expanded version of the guidelines document for submission for policy approval.

2.3.3.4 Application

The recommended strategy for application of the SQGs is summarized as follows:

1. No-effect Level

   i. Effluent limits for new discharges must be tailored to ensure continued protection of existing sediment quality.
   ii. Remedial action or source control not required.

2. Between No-effect Level and Lowest Effect Level

   i. Monitor biological resources to verify whether effects are present, and at what level.

3. Lowest Effect Level

   i. Investigation to determine sources and effects.
   ii. Control of existing sources, if feasible.
   iii. Effluent limits on potential new sources to control further degradation.
   iv. Prediction of recovery to No-effect Levels.

4. Limit of Tolerance

   i. Immediate investigation to determine sources and effects.
   ii. Control of existing sources.
   iii. In-situ remedial action, where appropriate.
   iv. Continued monitoring.

It is stressed that guidelines for the protection of aquatic biological resources for areas that correspond to the MOE's water quality Policy 1 areas (i.e. areas with water quality better than the objectives, see ref. 23) would employ only the No-effect Levels, since the other two levels are demonstrated effects levels. The Lowest Effect Level and the Limit of Tolerance are management action levels for remediation of affected areas corresponding to the MOE's Policy 2 areas (i.e. areas with water quality not meeting the objectives) and do not represent permissible levels of contamination.

As stated earlier, the Water Resources Branch intends that the SQGs replace the existing Open Water Disposal Guidelines. The new open water disposal guidelines would be represented by the Lowest Effect Level guidelines shown in Table 8. Open water disposal would be prohibited in areas corresponding to Policy 1 areas (this prohibition will likely actually apply to all areas with sediment quality lower than the Lowest Effect Level guidelines) to prevent degradation of existing sediment quality. These proposals will be clarified in a Sediment Management Strategy document currently being prepared by WRB.

2.3.3.5 Limitations and Precautions

The SQGs rely heavily on the SLC (Screening Level Concentration) approach. Implicit in this approach is the assumption that the data base includes concentrations over the full range of tolerance for each species. This is important though often difficult to verify.

The major limitation of the SLC approach is the difficulty in determining a direct cause-effect relationship between any one contaminant and the benthic biota, since very rarely is a single contaminant present in natural situations. Therefore, the measured cause-effect actually is related to the entire mixture of chemicals.

The SQGs also rely heavily upon determinations of background concentrations. Where data are insufficient to allow for determinations of no-effect levels or SLC lowest effect levels, mean background levels are substituted. Clearly, such background level guidelines have no biological basis. Also of some concern is the manner in which average background concentrations are determined. The main stipulation for collection of background samples concerned depth rather than geographic location. Samples were considered to be background provided they were collected from a depth of at least 10 cm below the surface of the sediment, in order that the sample would be representative of pre-colonial sediments. Downward movement of surface contaminants into this deeper material was assumed to be insignificant.

A consultant recommended that a minimum of 20 sample results was adequate to determine average background concentrations. At present, insufficient data are available for most contaminants to prove the statistical validity of this assumption for province-wide application.

The authors state that further refinement on a regional basis is desirable, so that site-specific guidelines can be developed. This philosophy is essentially the opposite of

that adopted in the development of the Upper Limit of Normal and Clean-up Guidelines, where it has been considered preferable to develop general guideline numbers for province-wide application, where justified by the data, rather than site-specific numbers which may have a stronger scientific basis but are logistically more cumbersome.

2.3.4 Dredged Material Guidelines

2.3.4.1 Derivation and Rationale

"Guidelines for the Management of Dredged Material in Ontario" (ref. 26) have been drafted by Waste Management Branch. The objective of the guidelines is to ensure that dredged material is managed in a consistent manner, with due regard to physical and chemical characteristics to ensure protection of environmental quality.

The guidelines propose a tiered approach of classification options, proceeding from lesser to greater degree of contamination as follows:

1. Open Water Disposal

   If contaminant concentrations in dredged material meet the MOE Open Water Disposal Guidelines (Section 2.3.2 and Table 7), open water disposal may be permitted. Disposal on inland lakes is at the discretion of the MOE.

2. Unrestricted Land Use

   Criteria for unrestricted disposal of dredged material on land are derived from the Sludge Utilization Guidelines (Section 2.1.1 and Table 1), and represent the maximum permissible metal contents in sludged agricultural soil. Material satisfying these guidelines may be placed on any land with the owner's approval, or at an engineered, confined location. MOE concurrence is required.

3. Restricted Land Use

   The restricted land use criteria represent the MOE Upper Limit of Normal (ULN) Guidelines for urban Ontario surface soil, as described in Section 2.2.1 and shown in Table 3. Dredged material with contaminant concentrations higher than the unrestricted criteria but lower than the urban ULN guidelines may be placed on lands zoned commercial or industrial only, or at an engineered, confined location. MOE concurrence is

required, and an inventory of such locations will be maintained by the MOE. The Dredged Material Guidelines state that such material must also be analyzed according to the Reg. 309 leachate extraction procedure, and presumably contaminants must leach at less than 10 times the Leachate Quality Criteria in order to qualify (see Section 2.3.1 and Table 6).

4. "Waste"

The guidelines propose that dredged material not satisfying the restricted land use criteria be classified as a "waste", and thus be subject to Part V of the Environmental Protection Act and Regulation 309. Such material would therefore require disposal at a certified waste disposal site.

5. Hazardous Waste

Dredged material that is defined as a "hazardous waste" according to Reg. 309 must, of course, be disposed of only at a hazardous waste disposal site (Section 2.3.1).

The derivation and rationale for the various criteria incorporated in the Dredged Material Guidelines (i.e. Open Water Disposal Guidelines, maximum permissible metal content in sludged soil, Upper Limit of Normal Guidelines, and Reg. 309 classification) were previously described in this report.

2.3.4.2 Parameters and Guideline Numbers

The criteria for classifying dredged material are shown in Table 9, which is taken from ref. 26.

The parameters in the table are divided into three groups. Group 1 parameters (cadmium, lead, mercury, PCBs) are to be strictly enforced because they are cumulative poisons. Exceedance of any one value in any sample will exclude the material from the particular disposal option. Group 2 parameters are of generally lesser concern; averaging of results may be allowed and there is some flexibility in considering such factors as naturally high background concentrations.

There are several inconsistencies between the criteria shown in this table and the source documents cited. These are:

1. For both unrestricted and restricted land use, a PCB guideline of 2 ppm is given, yet neither the Sludge Utilization Guidelines nor the Upper Limit of Normal

TABLE 9

DREDGED MATERIAL MODEL CLASSIFICATION CRITERIA

PARAMETER	OPEN WATER DISPOSAL	UNRESTRICTED LAND USE	RESTRICTED LAND USE
1)			
CADMIUM	1.0	1.6	4.0
LEAD	50.0	60.0	500.0
MERCURY	0.3	0.5	0.5
PCB'S	0.05	2.0	2.0
2)			
ARSENIC	8.0	14.0	20.0
COPPER	25.0	100.0	100.0
ZINC	100.0	220.0	500.0
CHROMIUM	25.0	120.0	120.0
IRON	10,000.0	35,000.0	35,000.0
NICKEL	25.0	32.0	60.0
COBALT	50.0	20.0	25.0
SILVER	0.5	N/A	N/A
CYANIDE	0.1	N/A	N/A
MOLYBDENUM	N/A	4.0	4.0
SELENIUM	N/A	1.6	2.0
3)			
LOSS ON IGNITION	6.0%	Group 3) parameters only apply to the Open Water Disposal option.	
OIL & GREASE	1500		
TOTAL PHOSPHORUS	1000		
TOTAL KJELDAHL NITROGEN	2000		
AMMONIA	100.0		

NOTES:

1) ALL CONCENTRATIONS ARE MAXIMUM PERMISSIBLE.

2) CONCENTRATIONS ARE EXPRESSED IN PPM DRY WEIGHT UNLESS OTHERWISE SPECIFIED.

3) ADDITIONAL PARAMETERS MAY BE REQUESTED BY THE REVIEWER BECAUSE OF KNOWN DISCHARGES. THIS MAY INCLUDE ANALYSES FOR ORGANICS, AND OTHER POLLUTANTS NOT INCLUDED IN THE CURRENT LIST.

4) MATERIALS NOT COMPLYING WITH ANY OF THE ABOVE WILL BE EITHER LAND-FILLED IN A CERTIFIED WASTE DISPOSAL SITE, OR, IF HAZARDOUS WASTE BY DEFINITION, TRANSPORTED TO A HAZARDOUS WASTE TREATMENT/DISPOSAL FACILITY, IN ACCORDANCE WITH REG. 309.

5) IN THE TABLE, N/A MEANS NOT APPLICABLE.

Guidelines contain a number for PCBs. As discussed in Section 3.2.1, a Federal (i.e. CCME) PCB guideline of 0.5 ppm has been recommended for agricultural soils and home gardens.

2. The Sludge Utilization Guidelines do not contain a number for iron. The 35,000 ppm figure is evidently taken from the Upper Limit of Normal Guidelines.

3. The restricted land use guideline for chromium (120 ppm) does not equal the ULN guideline for chromium (which is 50 ppm). Evidently, because the sludge guideline for chromium was higher than the ULN, the sludge guideline was utilized for both land uses.

4. Similarly, the ULN guideline for molybdenum is 3 ppm. The sludge guideline (4 ppm) appears to have been utilized for both land uses.

2.3.4.3 Status

The "Guidelines for the Management of Dredged Material in Ontario" (ref. 26) have been approved by Policy Committee but have not been approved by the Minister's Office as official MOE policy (pending this Committee's review).

2.3.4.4 Application

The guidelines are intended to apply to all forms of dredging throughout the province. Dredging is defined in the guidelines as "the planned, mechanical movement of material located below the surface of a water body, or at the land/water interface".

The classification process described in the guidelines applies to dredged material originating from commercial, industrial and public sector undertakings. Not covered by the guidelines are agricultural drainage activities managed by Ontario municipalities under the Drainage Act and governed by guidelines established by the Ministry of Agriculture and Food, and resource recovery activities under the Beach Protection Act administered by the Ministry of Natural Resources.

Exemptions from the classification process for dredging projects designated non-commercial, non-industrial or non-public sector (e.g. cottage owners), may be made at the discretion of the MOE Regional Director.

2.3.4.5 Limitations and Precautions

As discussed in Section 2.3.3, the Water Resources Branch

has recently recommended new Open Water Disposal Guidelines which are based upon observed environmental effects.

There are several contaminants for which guidelines for one or more disposal options have not been defined. Table 9 indicates that guidelines are "not applicable" in these instances. However, it would be more correct to state that guidelines have not yet been developed in these instances, and efforts should be directed to this end.
According to the proposed Dredged Material Guidelines, contaminant concentrations exceeding the Upper Limit of Normal (ULN) Guidelines for urban soil would result in the material being considered "waste", which is subject to Section V and Reg. 309 requirements for disposal. However, because the ULN guidelines are not "effects-based", it is questionable whether they should be so employed.

A more reasonable and defensible approach might be to use the Clean-up Guidelines (Section 2.2.2) for residential/ parkland/agricultural soils as restricted land use criteria [allowing material meeting these guidelines to be disposed of, in a controlled fashion, on commercial/industrial land and certain public sector lands (e.g. rights-of-way)]. Material exceeding the residential clean-up numbers and/or ten times the Reg. 309 Leachate Quality Criteria (Table 6) would therefore be designated as waste and require certified landfill disposal. This approach is similar to that suggested in ref. 22.

Use of the Sludge Utilization Guidelines to determine material that qualifies as unrestricted fill seems reasonable. The sludge guidelines were established in a very conservative manner (quasi effects-based), and land disposal of material meeting these criteria should not result in any negative environmental effects.

2.3.5 Backfill and Construction Application Guidelines

2.3.5.1 Derivation and Rationale

Canviro Consultants were awarded a contract from WMB to prepare "Guidelines for the Utilization of Industrial Wastes in Backfill and Construction Applications" (ref. 27). They have proposed a classification process which is intended to facilitate the use, rather than disposal, of industrial waste materials, and thus extend the life of landfills. Although industrial waste materials would not normally consist of "excavated material", the Canviro guidelines are discussed in this section of the report because they are similar in many respects to the Dredged Material Guidelines discussed above. Inclusion at this point facilitates direct

comparisons of the two guidelines.

A "Schedule of Acceptable Wastes and Uses" is being prepared which will list by common name and description various industrial wastes which are deemed acceptable for specified use categories. Wastes listed in the Schedule will not normally require additional chemical analysis of bulk or leachate quality prior to their use in the designated manner.

The proposed classification process for industrial waste materials is summarized as follows:

1. Regulation 309 Classification

   The Canviro guidelines state that the procedures of Reg. 309 are the first step in evaluating industrial wastes for backfill and construction applications. Wastes classified as "hazardous" (Section 2.3.1) will not be considered for such applications. Wastes classified as non-hazardous but subject to registration (i.e leachate quality between 10 and 100 times Schedule 4) may be considered for restricted land use or construction applications (see below). [Note that the use of registerable waste as backfill is in opposition to the proposed Dredged Material Guidelines (Section 2.3.4)].

2. Lakefill/Shoreline Disposal (Use Category 1)

   If contaminant concentrations in industrial waste material meet the MOE Open Water Disposal Guidelines (Section 2.3.2), and concentrations in leachate are less than 10 times the Provincial Water Quality Objectives (Table 10), the material is suitable for lakefill or shoreline disposal (subject to MOE site approval and possible additional testing requirements). [The guidelines document specifies that the Reg. 309 acid leachate extraction procedure must be used. However, the proposed MOE Lakefill Guidelines (Section 2.3.7) specify a distilled water leach for comparison with water quality objectives.]

3. Unrestricted Land Use (Use Category 2)

   If contaminant concentrations in industrial waste material are lower than the lower of either the maximum permissible metal contents in sludged agricultural soil as given in the Sludge Utilization Guidelines (Section 2.1.1) or the Upper Limit of Normal Guidelines for rural soil (Section 2.2.1), and the leachate concentrations are less than 10 times the Reg. 309

Leachate Quality Criteria (Section 2.3.1), the material is suitable for unrestricted land placement (subject to MOE site approval and possible additional testing requirements).

4. Restricted Land Use (Use Category 3)

If contaminant concentrations in industrial waste material are lower than the Upper Limit of Normal Guidelines for urban soil (Section 2.2.1), and the leachate concentrations are less than 100 times the Reg. 309 Leachate Quality Criteria, the material may be considered for land placement on commercial or industrial lands, and perhaps parkland (subject to MOE approval and possible requirements for additional testing). Registration of the presence of residual contamination is required (preferably on title) so that limitations on land use are evident in the event of sale or transfer.

5. Construction Use (Use Category 4)

All non-hazardous industrial wastes may be considered for construction applications (e.g. aggregate for asphalt manufacture). Neither additional testing nor MOE review and approval will normally be required for wastes listed in the Schedule of Acceptable Wastes and Uses (see Section 2.3.5.4).

6. Immobilization

Wastes not meeting leachate quality criteria but having acceptable bulk (i.e. total contaminant concentration) quality for lakefill, unrestricted or restricted land use, may be considered for immobilization. Once immobilized, the waste must be reclassified according to the above criteria.

The derivation and rationale for the Provincial Water Quality Objectives, which are discussed later in this report (Section 2.3.7), are described in ref. 23 and 28.

The derivation and rationale for the other criteria incorporated in the Backfill and Construction Application Guidelines (i.e. Open Water Disposal Guidelines, maximum permissible metal content in sludged soil, Upper Limit of Normal Guidelines and Reg. 309 classification) have been described previously in this report.

TABLE 10

PROVINCIAL WATER QUALITY OBJECTIVES/GUIDELINES

Parameter	PWQO/PWQG** (ug/l or ppb)
Ammonia	20
Arsenic	100
Beryllium	11[1]
Cadmium	0.2
Chlorine	2
Chromium	100
Copper	5
Cyanide	5
Hydrogen Sulphide	2
Iron	300
Lead	5[2]
Mercury	0.2
Nickel	25
Oil and Grease	_[3]
Phosphorus	20[4]
Selenium	100
Silver	0.1
Zinc	30
Trace Organics	
Aldrin*	0.001[5]
Dieldrin*	0.001[5]
Benzo-a-pyrene*	_[6]
Benzo(g,h,i)perylene*	_[6]
bis(2-ethylhexyl)phthalate*	0.6
Chlordane*	0.06
Chlorpyrifos	0.001
DDT and Metabolites*	0.003
Diazinon	0.08
Dibenzo(a,h)anthracene*	_[6]
Dibutylphthalate	4
Dicamba	200
Dioxins and Furans*	_[6]
Diquat	0.5
Diuron	1.6
Dalapon	110
Endosulphan	0.003
Endrin	0.002
Fenthion	0.006
Fluorene*	_[6]
Guthion	0.005
HCB*	0.0065[7]
Heptachlor	0.001[5]
Heptachlor Epoxide	0.001[5]

Hexachlorocyclohexane*	_(6)
Hexachloroethane*	_(6)
Lindane	0.01
Malathion	0.1
Methoxychlor	0.04
Mirex (Dechlorane)*	0.001
Octachlorostyrene*	_(6)
Other Phthalates	0.2
Parathion	0.008
PCB*	0.001
Pentachlorobenzene*	0.03
Pentachlorophenol*	0.5
Phenols	1
Pyrethrum	0.01
Simazine	10
1,2,3,4 Tetrachlorobenzene*	0.10(7)
1,2,3,5 Tetrachlorobenzene*	0.10(7)
1,2,4,5 Tetrachlorobenzene*	0.15(7)
2, Chloronaphthalene*	_(6)
2,4-D	4

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* Considered as "Bioaccumulative Substance" for purposes of WRB Lakefill Guidelines (Section 2.3.7)

** Numbers are Provincial Water Quality Objectives (ref. 23) unless indicated otherwise

(1) 1100 ug/l where water hardness is >75 mg/l of $CaCO_3$

(2) up to 25 ug/l depending on hardness

(3) criteria are aesthetic (appearance, odour, taste)

(4) guidelines range from 10 to 30 ug/l depending on goal

(5) total of aldrin + dieldrin

(6) PWQO/PWQG currently under development by Water Resources Branch (ref. 29)

(7) Provincial Water Quality Guideline

2.3.5.2 Parameters and Guideline Numbers

The bulk quality criteria for backfill material classification are shown in Table 11, which is taken from ref. 26.

Although the parameters in the table are divided into three groups (similar to the divisions for the Dredged Material Guidelines), there is no discussion in the text of the document as to the significance of this division. All parameters are apparently treated with equal weight.

Also, as with the Dredged Material Guidelines, there are a number of inconsistencies between the criteria in the table and the source documents cited. These are:

1. Lakefill/shoreline bulk disposal criteria are given for boron, manganese, fluoride and phenols, but there are no Open Water Disposal Guidelines listed for these parameters in the relevant WRB guidelines documents (ref. 24, 25). The criterion given for manganese (0.5 ppm) is extremely low.

2. The unrestricted land use criteria for most parameters represent the lower of the sludged soil guideline and the rural Upper Limit of Normal (ULN) Guideline. However, for mercury, the 0.5 ppm sludge guideline was used, which is higher than the 0.15 ppm ULN guideline, while for cobalt, the 25 ppm ULN guideline was used, which is higher than the 20 ppm sludge guideline. The higher values for these two parameters may have been chosen because the lower values are lower than the Open Water Disposal Guidelines. For cobalt, both the unrestricted and restricted land use criteria remain lower than the lakefill criterion.

3. The unrestricted and restricted land use criteria for iron should be 35,000 ppm (which is both the rural and urban ULN), not 350,000 ppm.

4. There are neither pertinent sludge guidelines nor ULNs for loss on ignition, oil and grease, total phosphorus, total nitrogen or ammonia. The unrestricted and restricted land use criteria were evidently made equal to the lakefill (i.e. Open Water Disposal) criteria. But there are other situations (e.g. silver, cyanide) where this was not done.

5. As stated in Section 2.3.4.2, there are at present no sludge or ULN guidelines for PCBs in Ontario soils. The source of the 2 ppm criterion given in the table should be clarified.

TABLE 11

BACKFILL MATERIAL CLASSIFICATION CRITERIA

(all units in ppm unless otherwise specified)

PARAMETER	LAKEFILL/SHORELINE DISPOSAL (BULK)	UNRESTRICTED LAND USE (BULK)	RESTRICTED LAND USE (BULK)
Cadmium	1.0	1.6	4.0
Lead	50.0	60.0	500.0
Mercury	0.3	0.5	0.5
PCBs	0.05	2.0	2.0
Loss on Ignition	6.0%	6.0%	6.0%
Oil & Grease	1500	1500	1500
Total Phosphorus	1000	1000	1000
Total Kjeldahl Nitrogen	2000	2000	2000
Ammonia	100.0	100.0	100.0
Grain Size	-	-	-
Visual Description	-	-	-
Arsenic	8.0	10	20.0
Copper	25.0	60	100.0
Zinc	100.0	220	500.0
Chromium	25.0	50	50
Iron	10,000.0	350,000	350,000
Nickel	25.0	32.0	60.0
Cobalt	50.0	25	25.0
Silver	0.5	-	-
Cyanide	0.1	-	-
Molybdenum	-	2	3
Selenium	-	1.6	2.0
Antimony	-	-	8
Boron	50	10	15
Manganese	0.5	700	700
Vanadium	-	70	70
Fluoride	24	-	-
Phenols	0.02	-	-

Notes: * Additional parameters may be requested by the reviewer because of known discharges.

2.3.5.3 Status

Canviro Consultants have prepared a draft final report for Phase I of the "Guidelines for the Utilization of Industrial Wastes in Backfill and Construction Applications" (ref. 27) for Waste Management Branch. Phase II of the project involves field trials of selected wastes to determine if the criteria proposed in Phase I are realistic. A report describing the results of the field trials and fine-tuning the Phase I proposed guidelines is in preparation.

As part of the Phase I report, Canviro evaluated several industrial wastes, including cement kiln dust, sewage sludge incinerator ash, coal ash and foundry waste (including foundry sand, see Section 2.3.6), for potential acceptability as backfill materials under the proposed guidelines. None of the wastes were deemed suitable for inclusion in Use Categories 1, 2 or 3 (i.e. lakefill disposal, unrestricted land use or restricted land use, respectively) of the Schedule of Acceptable Wastes and Uses, as described in the Phase I report.

2.3.5.4 Application

Once approved, the Backfill and Construction Application Guidelines would have potential application to many industrial wastes generated within the province. However, in order for a waste to be included in the Schedule of Acceptable Wastes and Uses, it must first be demonstrated that it meets the approved bulk and leachate quality either on an industry-wide or generating establishment specific basis, and it also must have a well-documented history of beneficial use in Ontario.

It is stressed that wastes that do not appear on the Schedule of Acceptable Wastes and Uses may still be eligible for backfill or construction applications provided testing demonstrates that they have acceptable bulk and leachate quality according to the classification process described above.

2.3.5.5 Limitations and Precautions

Comments made earlier in Section 2.3.4.5 (Dredged Material Guidelines) concerning the new Open Water Disposal Guidelines and the questionable use of ULN guidelines to classify wastes also apply to the Backfill and Construction Application Guidelines. The use of the urban ULN guidelines to set limits for acceptability for restricted land use may be unnecessarily stringent, particularly for some contaminants such as boron and chromium, for which demonstrated "effects" levels (for any land use) are much

higher. The agricultural/residential/parkland Clean-up Guidelines could be considered for this purpose (provided parkland is not approved to receive such material, although this is suggested in the Backfill Guidelines).

The Backfill Guidelines state that all non-hazardous industrial wastes may be considered for construction applications, but, other than the requirement that Reg. 309 leachate levels are <100 times the Schedule 4 levels, there is no indication of requirements for further evaluation. There are questions of volatility and mobility of contaminants that should be addressed.

The authors of the Backfill and Construction Application Guidelines suggest a number of additional precautions and limitations in their report. Among these are the question of long-term liability for environmental and health impacts resulting from use of industrial wastes in the manner proposed. Also raised is the problem of a lack of criteria for organic contaminants. Both of these concerns are, of course, shared by many other environmental management guidelines. The authors suggest a list of organic contaminants which may be of concern in industrial wastes. Table 12 represents a list of those organics (mainly PAHs) potentially of concern for which the MOE has not yet established any general or contaminant-specific environmental quality criteria (although site-specific criteria have been developed for some; see Section 3.1.1) for water, soil, sludge or excavated material (i.e. organics not listed in Tables 14 or 18).

Yet another set of guidelines for land disposal of wastes (foundry sand) has been drafted. These will be discussed in the next section of this report. There are areas of potential conflict among the Dredged Material, Backfill and Foundry Sand Guidelines which will be addressed in Section 2.3.6.5.

2.3.6 Foundry Sand Guidelines

2.3.6.1 Derivation and Rationale

Foundry Sand Guidelines are actually specific (i.e. industry-specific) guidelines, and so could be discussed in Section 3 of this report. However, the guidelines are very closely related to both the Dredged Material and the Backfill and Construction Application Guidelines. In fact, foundry sand was one of the wastes evaluated by Canviro Consultants for use in lakefill, unrestricted and restricted land application, but found to be unacceptable at the present time due to a lack of analytical data and potential

TABLE 12

ORGANIC CONTAMINANTS OF CONCERN FOR WHICH THE MOE HAS NOT YET DEVELOPED ANY GENERAL ENVIRONMENTAL QUALITY GUIDELINES*

Benzenethiol
Cresol
2,4-Dimethylphenol
4-Nitrophenol
Anthracene
Butly benzyl phthalate
Chrysene
Dibenz(a,h)acridine
Dichlorobenzenes
Diethyl phthalate
7,12-Dimethylbenz(a)anthracene
Dimethylphthalate
Di(n)octyl phthalate
Fluoranthene
Indene
Methyl chrysene
1-Methyl naphthalene
2,4-Dinitrophenol
2-Methyl naphthalene
Picene
Quinoline
Dimethyl sulphate
Pyridine
Monomethyl sulphate
1,2,4-Trichlorobenzene
Acenaphthylene
1,2-Benzofluorene
2,3-Benzofluorene
1-Methylphenanthrene
2-Methylanthracene
9,10-Dihydroanthracene
1,6-Dimethylnaphthalene
1,3-Dimethylnaphthalene
2,6-Dimethylnaphthalene
1,5-Dimethylnaphthalene
2,3-Dimethylnaphthalene

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* As identified by Canviro Consultants (ref. 27)

problems with fluoride and phenols (ref. 27). Inclusion of the Foundry Sand Guidelines at this point in the report will facilitate comparisons with these other related guidelines.

A document entitled, "A Methodology to Assess Foundry Sand as Fill Material" has recently been drafted by Waste Management Branch (ref. 30). This document arose from a request to the MOE from the Canadian Foundry Association for guidelines for the use of waste foundry sand in backfill and construction projects.

The proposed MOE Foundry Sand Guidelines are comprehensive in that they require the proponent to submit information concerning the following aspects to the MOE for consideration of the sand as fill material:

1. Foundry processes/operations, including reasons why the sand cannot be reused at the foundry.

2. Analytical data for comparison with Schedules A and B (Section 2.3.6.2), including confirmation that the sand is neither a Leachate Toxic Waste (i.e. acid leach concentrations >100 X Schedule 4 of Reg. 309) nor a registerable solid waste (i.e. acid leach concentrations between 10 and 100 X Schedule 4; see Section 2.3.1).

   The Schedule A criteria are bulk analysis criteria which represent the MOE's soil clean-up (decommissioning) guideline numbers (Section 2.2.2) for agricultural/residential/parkland or commercial/ industrial land use. Bulk analysis must be conducted for all contaminants listed in both Schedules A and B, and also for organics (i.e. organic scan).

   The Schedule B criteria are leachate criteria for a distilled water leach test (rather than the acid leach test specified in Reg. 309). Three sets of criteria numbers are given:

   i) Criteria for fill placement at least 15 m from surface water and 50 m from wells - These criteria appear to represent Ontario Drinking Water Objectives for most of the contaminants listed (see Section 2.3.7).
   ii) Criteria for fill placement at least 50 m from both surface water and wells - These levels are twice the above criteria.
   iii) Criteria for fill placement on commercial/ industrial land only, and at least 50 m from both surface water and wells - These levels are usually 5 times (but in some cases only twice) the levels

in (i) above.

If the criteria in (iii) are exceeded, the foundry sand is considered by WMB to be subject to the requirements of Reg. 309, and disposal must be at a certified landfill site. Sands with leachate levels between 10 and 100 times those in Schedule 4 of Reg. 309 are subject to generator registration, while if leachate levels are >100 times Schedule 4, the sand is hazardous waste and must be manifested.

The guidelines document states that if contaminants listed on Schedule B are not detected in the bulk Schedule A testing, then distilled water leach tests for these contaminants are not required.

3. Aesthetics.

4. Proposed land use.

5. Previous use (disposal) of sand.

6. Proposed quality control program at foundry.

7. Monitoring program at disposal site.

8. Notification requirement.

Details of the above are found in ref. 30.

The Foundry Sand Guidelines utilize the terms "agricultural/residential/parkland" and "commercial/industrial" in place of the terms "unrestricted" and "restricted" that had been used to this point (i.e. in both the Dredged Material and the Backfill and Construction Application Guidelines) to delineate allowable land placement categories. This new terminology is consistent with that employed in the Decommissioning Guidelines (Section 2.2.2).

2.3.6.2 Parameters and Guideline Numbers

Schedule A of the Foundry Sand Guidelines document contains Bulk Analysis Criteria. Guidelines are given for arsenic, cadmium, chromium VI, total chromium, copper, lead, mercury, selenium, silver and zinc. They are identical to the Clean-up Guidelines (Section 2.2.2 and Table 4).

The Schedule B Leachate Criteria are given in Table 13, which is taken from ref. 30. The criteria numbers for placement of sand at least 15 m from surface water [category (i) above] for arsenic, cadmium, chromium, cyanide, fluoride, lead, mercury, PCBs, selenium, silver and

TABLE 13

SCHEDULE B LEACHATE CRITERIA (mg/l)
FOR FOUNDRY SAND

CONTAMINANT	15m FROM SURFACE WATER	50m FROM WELLS	COMMERCIAL/ INDUSTRIAL
ARSENIC	0.05	0.1	0.25
CADMIUM	0.005	0.01	0.025
CHROMIUM	0.05	0.1	0.25
COPPER	5.0	10.0	10.0
CYANIDE	0.2	0.4	1.0
FLUORIDE	2.4	4.8	12.0
IRON	1.5	3.0	3.0
LEAD	0.05	0.10	0.25
MERCURY	0.001	0.002	0.005
PCB	0.003	0.006	0.015
PHENOLS	0.01	0.02	0.02
SELENIUM	0.01	0.02	0.05
SILVER	0.05	0.10	0.25
TRIHALOMETHANES	0.35	0.70	1.75
ZINC	25	50	50

trihalomethanes are Ontario Drinking Water Objectives representing "maximum acceptable concentrations" for parameters related to health (ref. 20), and also appear in Schedule 4 of Reg. 309. The rationale for the numbers for the other contaminants (copper, iron, phenols and zinc) is not obvious but they are equal to five times the Ontario Drinking Water Objectives representing "maximum desirable concentrations" for parameters related to aesthetic quality (ref. 20). The numbers for sand placement at least 50 m from wells [category (ii)] are twice these levels, while the numbers for placement on commercial/ industrial land [category (iii)] are generally five times the category (i) levels, except for copper, iron, phenols and zinc, where they remain at twice the category (i) numbers.

The heading for category (ii), "50 m from wells" should be changed to "50 m from surface water" to distinguish it more clearly from category (i), because in fact all three categories of placement require a minimum distance of 50 m from wells used as a source of potable water.

2.3.6.3 Status

The document entitled, "A Methodology to Assess Foundry Sand as Fill Material" is currently in draft form, and has been circulated within the MOE for comment. Waste Management Branch has not decided whether to proceed with the formal approvals process for the guidelines (i.e. submission to MOE Policy Development and Coordination Committee) (ref. 16).

2.3.6.4 Application

The Foundry Sand Guidelines are industry-specific guidelines that would be applicable only to the disposal of waste foundry sand produced in Ontario.

2.3.6.5 Limitations and Precautions

The Foundry Sand Guidelines are similar to the Dredged Material Guidelines (Section 2.3.4) and the Backfill and Construction Application Guidelines (Section 2.3.5) in that all three address use and disposal options for material which is not classified as a hazardous waste. The need for three different sets of such guidelines is surely open to question.

A review and comparison of the three guidelines reveals a number of major conflicts and inconsistencies:

1. The bulk analysis criteria for the Foundry Sand Guidelines are the Clean-up Guidelines for soils (Section 2.2.2). This is in contrast with the criteria

stipulated for similar land uses (i.e. unrestricted = agricultural/residential/parkland; restricted = commercial/industrial) in both the Dredged Material and the Backfill Guidelines (Sections 2.3.4 and 2.3.5, respectively), which utilize maximum permissible metal concentrations in sludged agricultural soil (Section 2.1.1) and/or Upper Limit of Normal (ULN) Guidelines (Section 2.2.1). In principle, the use of Clean-up Guidelines may be more justifiable because they are mainly "effects-based" whereas the sludge guidelines are quasi-effects-based while the ULNs are not at all. However, the Foundry Sand Guidelines propose to allow disposal on land of material with contaminant levels which could be just marginally below the clean-up levels, i.e. there is no real "margin for error".

Consistent with the Dredged Material Guidelines (Section 2.3.4), consideration should be given to using the maximum metal concentrations in sludged agricultural soil (Section 2.1.1) as the basis for criteria for agricultural/residential/parkland (i.e. unrestricted) application. Similarly, consideration should be given to using the Clean-up Guidelines for agricultural/residential/parkland use as the basis for commercial/industrial (i.e. restricted) application of these various materials. This practice would allow a margin for error and would not amount to a "license to pollute".

2. The Foundry Sand Guidelines also utilize leachate criteria to determine allowable land disposal practices, as do the Dredged Material and the Backfill Guidelines. However, the origin of the leachate criteria contained in the Foundry Sand Guidelines is not explained. The most restrictive leachate criteria (for placement at least 15 m from surface water) are equal to the Ontario Drinking Water Objectives for most, but not all, contaminants. Also, a distilled water leach test is specified for comparison with the criteria, rather than a Reg. 309 acid leach test, although foundry sand with distilled water leach concentrations exceeding the most liberal criteria category (commercial/industrial land application) is said to be subject to Reg. 309 (requiring landfill disposal).

3. There are inconsistencies among the Foundry Sand, Dredged Material (Section 2.3.4) and Backfill and Construction Application (Section 2.3.5) Guidelines in the manner in which leachate quality criteria are used to determine suitability for land use. This is illustrated in Table 14.

TABLE 14

COMPARISON OF LEACHATE DISPOSAL CRITERIA FOR DREDGED MATERIAL, BACKFILL/CONSTRUCTION APPLICATION AND FOUNDRY SAND GUIDELINES

Disposal Option	Dredged Material Criteria	Backfill Criteria	Foundry Sand Criteria
Lakefill	leachate tests not required	10 X PWQOs* (Reg. 309 acid leach)	no lakefill disposal option
Unrestricted (Agricultural/ residential)	leachate tests not required	10 X Schedule 4 (Reg. 309 acid leach)	1, 2, 5 or 10 X ODWOs** (distilled water leach); 10 X Schedule 4 (Reg. 309 acid leach)
Restricted (Commercial/ Industrial)	10 X Schedule 4 (Reg. 309 acid leach)	100 X Schedule 4 (Reg. 309 acid leach)	5 or 10 X ODWOs (distilled water leach); 10 X Schedule 4 (Reg. 309 acid leach)

* PWQOs = Provincial Water Quality Objectives (Section 2.3.7.1).
** ODWOs = Ontario Drinking Water Objectives (ref. 20 and 21).

The major difference between the leachate criteria for foundry sand and the criteria for both backfill and dredged material is that the former requires distilled water leach tests and comparison with Ontario Drinking Water Objectives (most of which are identical to the Reg. 309 Schedule 4 criteria), as well as the Schedule 4 acid leach test, whereas the latter two require only the Reg. 309 acid leach test.

It is apparent that the acid leach criteria for backfill are much more lenient than the acid leach criteria for dredged material and foundry sand for restricted (i.e. commercial/industrial) land use. The Backfill and Construction Application Guidelines actually propose to allow disposal on commercial, industrial and perhaps even parkland of material that could fall marginally short of being classified as a hazardous waste (e.g. 99 X Reg. 309 leachate quality criteria).

In practice, however, it is extremely unlikely that material even remotely approaching the hazardous waste criterion would be disposed of in this manner, provided bulk testing was properly carried out. This is because the ULN guidelines used to classify material for restricted land use are generally very conservative, and much higher bulk concentrations of contaminants would be required to produce leachate levels which approach the hazardous waste criteria. The Dredged Material criteria provide a much better "fit" between bulk concentrations and leachate criteria (i.e. urban ULNs = 10 X Reg. 309 criteria), but even here the urban ULNs are probably conservative for most parameters.

4. The Foundry Sand Guidelines are the only one of the three to incorporate criteria for minimum distances of fill sites from surface water and wells. Similar requirements could be considered for inclusion in all guidelines governing land placement of material.

2.3.7 Lakefill Guidelines

Two sets of lakefill guidelines have recently been prepared for use in Ontario, the one by the Water Resources Branch ("Guidelines for Lakefilling Activities in Ontario"; ref. 29), and the other by the Metro Toronto and Region Conservation Authority ("The Manual for an Improved Lakefill Quality Control Program"; ref. 19). In this discussion, these will be referred to as the WRB Lakefill Guidelines and the MTRCA Lakefill Guidelines, respectively.

2.3.7.1 Derivation and Rationale

1. WRB Lakefill Guidelines

The WRB Lakefill Guidelines are divided into three main areas: Environmental Criteria, Administrative Controls, and Implementation Procedures. Of main concern in the present exercise is the former, Environmental Criteria. Details of the latter two areas may be found in ref. 29.

According to the WRB approach, material being considered for lakefill must meet certain initial screening criteria to qualify as Restricted Fill. These criteria are:

i) the agricultural/residential/parkland Clean-up Guidelines for medium and fine textured soils (see Section 2.2.2 and Tables 4 and 5)
ii) the Reg. 309 Schedule IV Leachate Quality Criteria [results must be $\leq$1x criteria (i.e. Drinking Water Objectives) shown in Table 15].

(It should be noted that a requirement for a Distilled Water Leach Test contained in the March 1989 draft of the WRB guidelines has since been deleted).

Material that passes these initial screening requirements qualifies as Restricted Fill. Such fill can be used for lakefilling provided it is placed within a securely-confining structure (see ref. 29).

According to the WRB Lakefill Guidelines, in order to qualify as Unrestricted Fill, i.e. be suitable for open water disposal (MOE Policy 2 areas only), material must meet the following additional criteria:

i) the Open Water Disposal Guidelines (Table 7, in future to be replaced by "Lowest Effect Level" Sediment Quality Guidelines in Table 8)
ii) be free of objectionable substances such as

vegetation, wood, paper, plastics, metal scraps, odorous and colour-imparting substances

iii) pass receiving water simulation tests. Receiving water is to be simulated by placing one part of fill material to twenty parts of distilled water and agitating for 24 hours. After settling for one hour, aliquots of the supernatant are used in the following tests: a) Rapid Lethality - supernatant must pass standard 48-hour LC50 Daphnia test (ref. 31) or an equivalent MOE-approved test; b) Bioaccumulation - concentrations of bioaccumulative substances in supernatant must be below the Provincial Water Quality Objectives/Guidelines shown in Table 10; c) Water Quality Impairment - concentrations of contaminants in supernatant must be $\leq$10x the PWQOs/PWQGs shown in Table 10.

The rationale for the soil Clean-up Guidelines, the Open Water Disposal Guidelines and the Reg. 309 Leachate Quality Criteria, all of which are incorporated in the WRB Lakefill Guidelines, have been previously described.

Provincial Water Quality Objectives/Guidelines, which are also utilized in the WMB (Canviro) Backfill and Construction Application Guidelines (Section 2.3.5), are designed to protect the most sensitive water use, and therefore represent "no-effect" levels. The use of a 10 X factor in the guidelines allows for a 10:1 dilution in the near field of the lakefill dumping operation. The derivation and rationale for the PWQOs are described in ref. 23 and 28.

2. MTRCA Lakefill Guidelines

The MTRCA Lakefill Guidelines are described in a manual (ref. 19) prepared by Trow, Dames and Moore Consultants on behalf of the Metro Toronto and Region Conservation Authority, in consultation with Central Region MOE. The manual describes a lakefill management system known as the "Improved Lakefill Quality Control Program (ILQCP)". This program consists of processes, techniques and methods to be followed to assess the acceptability and suitability of material for placement at lakefill locations administered by the MTRCA. It has been designed to provide a consistent Metro-wide guideline for the assessment of fill quality.

Under the ILQCP, sites to be excavated are classified according to the volume of excavated material. "Large Sites" are those which produce $\geq$ 200 m^3 of material.

They require an application which includes a pre-disposal inspection Environmental Report before the Bill of Lading (required for access to lakefill location) is released, and must be registered with the MTRCA in advance of the proposed site activity. The Environmental Report presents results of chemical sampling required in order to classify the material for disposal, according to the following procedure:

i) material is suitable for open water disposal if Open Water Disposal Guidelines (Section 2.3.2 and Table 7) are met
ii) material is eligible for "protected" or "confined" lakefill disposal if Dredged Material Restricted Land Use Guidelines (Section 2.3.4 and Table 9) are met
iii) material is suitable for Protected Lakefill Disposal (requiring enclosure on three sides by land above the high water mark) if Distilled Water Leach Test (ref. 29) results meet the Ontario Drinking Water Objectives for 17 contaminants (Table 15);
iv) material may be placed in Confined Lakefill Disposal (not defined in Manual) if Distilled Water Leach Test results exceed Drinking Water Objectives.

"Small Sites" (<200 m^3 of material) also require pre-registration with the MTRCA and application for Bills of Lading but will not normally require a pre-disposal inspection Environmental Report. However, untested material from small sites is not eligible for open water disposal and may only be disposed of in protected or confined areas at a lakefill location.

Staff of the MTRCA have recently recommended a change in the guidelines, in that developers of all small sites would be required to submit a lakefill application to the MTRCA at least five days prior to initiation of site activities. This would enable on-site pre-excavation inspections of all sites (ref. 32).

In addition to the above testing requirements, the MTRCA manual stipulates that at the lakefill location, Gate Inspectors will visually inspect all lakefill material for evidence of oil or other potential contaminants and will also monitor for the presence of odours. Hand-held photoionization detectors will allow quick identification of the presence of volatiles. Suspect loads will be denied access to the facility.

The rationale for the Open Water Disposal Guidelines

and the Restricted Land Use (Dredged Material) Guidelines, both of which are utilized in the MTRCA Lakefill Guidelines, have been previously described. The rationale for the Drinking Water Objectives, which also are used in the MTRCA guidelines (and which represent the health-based Leachate Quality Criteria of Reg. 309; see Section 2.3.1) is discussed in ref. 20 and 21.

It is apparent that the MTRCA Lakefill Guidelines differ from the WRB Lakefill Guidelines in the manner in which material for "restricted" fill applications is classified. Another perhaps more major point of difference is that in the WRB approach, material for open water disposal must pass other clearly defined chemical and toxicological tests in addition to the Open Water Disposal Guidelines.

2.3.7.2 Parameters and Guideline Numbers

Table 15 summarizes all of the testing requirements for determination of fill quality and associated guideline numbers utilized in the WRB and MTRCA Lakefill Guidelines.

2.3.7.3 Status

1. WRB Lakefill Guidelines

   The "Guidelines for Lakefilling Activities in Ontario" (ref. 29) have been approved by Policy Committee and Division Heads. However, at Management Committee level, although the text of the guidelines was approved in principal, the authors were instructed to prepare a revised lakefilling document which would contain other options (e.g. all lakefill material must be suitable for open water disposal; MTRCA approach; "do nothing" option). This revised and expanded document is then to be distributed for public comment. The revised document is currently in preparation by WRB staff.

2. MTRCA Lakefill Guidelines

   Procedures outlined in "The Manual for an Improved Lakefill Quality Control Program" (ref. 19) are currently being utilized on an interim basis, with the approval of the Minister of the Environment, by the Metro Toronto and Region Conservation Authority at lakefilling sites within their jurisdiction. These include the Leslie Street Spit and Colonel Sam Smith Park (temporarily inactive). In exercising authority over lakefilling activities, the MTRCA is acting as an agent of the MOE, on behalf of Central Region.

TABLE 15

LIST OF "QUALITY DETERMINANTS" AND ASSOCIATED NUMBERS UTILIZED BY WRB AND MTRCA LAKEFILL GUIDELINES

Parameter	Soil Clean-up[1] (ug/g or ppm)	Leachate Quality[2] (mg/l or ppm)	Open Water Disposal[3] (ug/g or ppm)	Sediment Quality[4] (ug/g or ppm)	PWQOs/ PWQGs[5] (ug/l or ppb)	Dredged Material[6] (ug/g or ppm)
Ammonia	-	-	100[11]	-	20	-
Antimony	25	-	-	-	-	-
Arsenic	25	0.05[7]	8.0	5.5	100	20
Barium	1000	1.0[7]	-	-	-	-
Boron	-	5.0[7]	-	-	-	-
Beryllium	5	-	-	-	11[12]	-
Cadmium	4	0.005[7]	1.0	1.0	0.2	3[13]
Chlorine	-	250[8]	-	-	2	-
Chromium (total)	1000	0.05[7]	25[11]	31.0	100	120
Chromium (VI)	10	-	-	-	-	-
Cobalt	50	-	50[11]	-	-	25
Copper	200	1.0[7]	25[11]	25.0	5	100
Cyanide	-	0.2[7]	0.1[11]	-	5	-
EC (mS/cm)	2	-	-	-	-	-
Fluoride	-	2.4[7]	-	-	-	-
Hydrogen Sulphide	-	-	-	-	2	-
Iron	-	-	10,000[11]	3.0%	300	35,000
Lead	500	0.05[7]	50.0	31.0	5[12]	375[13]
Mercury	1	0.001[7]	0.3	0.12	0.2	0.5
Molybdenum	5	-	-	-	-	4
Nickel	200	-	25[11]	31.0	25	60
Nitrate + Nitrite	-	10.0[7]	-	-	-	-
Nitrogen (Kjeldahl)	0.5 %	-	0.2%[11]	545.0	-	-
Oil and Grease	1 %	-	0.15%	2400.0	-[12]	5,000[14]
pH (recommended range)	6-8	-	-	-	6.5-8.5	-
Phosphorus	-	-	0.1%[11]	600.0	20[12]	-
Selenium	2	0.01[7]	-	-	100	2
Silver	25	0.05[7]	0.5[11]	-	0.1	-
Sodium Adsorption Ratio	5	-	-	-	-	-
TOC (Total Organic Carbon)	-	-	-	1.0%	-	-
Uranium	-	0.02	-	-	-	-
Vanadium	250	-	-	-	-	-
Volatile Solids	-	-	6%	-	-	-
Zinc	800	5.0[8]	100[11]	110.0	30	500
Trace Organics						
Aldrin*	-	0.0007[9]	-	0.002	0.001[9]	-
Dieldrin*	-	0.0007[9]	-	0.019	0.001[9]	-
Benzo-a-pyrene*	-	-	-	-	-[12]	-
Benzo(g,h,i)perylene*	-	-	-	-	-[12]	-
BHC	-	-	-	0.003	-	-
g-BHC	-	-	-	0.003	-	-
b-BHC	-	-	-	0.005	-	-
a-BHC	-	-	-	0.006	-	-
bis(2-ethylhexyl)phthalate*	-	-	-	-	0.6	-
Carbaryl (Sevin)	-	0.07	-	-	-	-
Chlordane*	-	0.007	-	0.008	0.06	-
g-Chlordane	-	-	-	0.005	-	-
Chlorpyrifos	-	-	-	-	0.001	-
DDT and Metabolites*	-	0.03	-	-	0.003	-
pp-DDT	-	-	-	0.009	-	-
pp-DDD	-	-	-	0.008	-	-

pp-DDE	-	-	-	0.005	-	-
op-DDT	-	-	-	0.006	-	-
Diazinon	-	0.0002	-	-	0.08 (12)	-
Dibenzo(a,h)anthracene*	-	-	-	-	-	-
Dibutylphthalate	-	-	-	-	4.0	-
Dicamba	-	-	-	-	200.0 (12)	-
Dioxins and Furans*	-	-	-	-	-	-
Diquat	-	-	-	-	0.5	-
Diuron	-	-	-	-	1.6	-
Dalapon	-	-	-	-	110.0	-
Endosulphan	-	-	-	-	0.003	-
Endrin	-	0.0002	-	0.003	0.002	-
Fenthion	-	-	-	-	0.006 (12)	-
Fluorene*	-	-	-	-	-	-
Guthion	-	-	-	-	0.005	-
HCB*	-	-	-	0.020	0.0065 (12)	-
Heptachlor	-	0.003 (10)	-	0.002	0.001 (10)	-
Heptachlor Epoxide	-	0.003 (10)	-	0.005	0.001 (10)	-
Hexachlorocyclohexane*	-	-	-	-	- (12)	-
Hexachloroethane*	-	-	-	-	- (12)	-
Lindane	-	0.004	-	-	0.01	-
Malathion	-	-	-	-	0.1	-
Methoxychlor	-	0.1	-	-	0.04	-
Methyl Parathion	-	0.007	-	-	-	-
Mirex (Dechlorane)*	-	-	-	0.007	0.001	-
Nitrilotriacetic Acid	-	0.05	-	-	- (12)	-
Octachlorostyrene*	-	-	-	-	-	-
Other Phthalates	-	-	-	-	0.2	-
Parathion	-	0.035	-	-	0.008	-
PCB*	-	0.003 (7)	0.05	0.041	0.001	2
PCB 1254	-	-	-	0.058	-	-
PCB 1248	-	-	-	0.034	-	-
PCB 1016	-	-	-	0.007	-	-
Pentachlorobenzene*	-	-	-	-	0.03 (12)	-
Pentachlorophenol*	-	-	-	-	0.50 (12)	-
Phenols	-	0.002 (8)	-	-	1	-
Pyrethrum	-	-	-	-	0.01	-
Simazine	-	-	-	-	10.0	-
Toxaphene	-	0.005	-	-	0.008	-
Trihalomethanes	-	0.35	-	-	-	-
1,2,3,4 Tetrachlorobenzene*	-	-	-	-	0.10 (12)	-
1,2,3,5 Tetrachlorobenzene*	-	-	-	-	0.10 (12)	-
1,2,4,5 Tetrachlorobenzene*	-	-	-	-	0.15 (12)	-
2, Chloronaphthalene*	-	-	-	-	- (12)	-
2,4-D	-	0.1	-	-	4.0	-
2,4,5-TP (Silvex)	-	0.01	-	-	-	-

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* Considered as "Bioaccumulative Substance" for purposes of WRB Lakefill Guidelines.

(1) See Section 2.2.2. Utilized in WRB Lakefill Guidelines.

(2) See Section 2.3.1. Represent Drinking Water Objectives utilized in both WRB and MTRCA Guidelines.

(3) See Section 2.3.2. Utilized in both WRB and MTRCA Lakefill Guidelines.

(4) See Section 2.3.3. Are "lowest effect levels" which will replace the Open Water Disposal Guidelines.

(5) See Section 2.3.7.1. Utilized in WRB Lakefill Guidelines.

(6) See Section 2.3.4. Are "restricted land use" guidelines utilized in MTRCA Lakefill Guidelines.

(7) Drinking Water Objectives for parameters specifically identified in MTRCA Lakefill Guidelines.

(8) Non health-related Drinking Water Objectives (not in Reg. 309) but listed in MTRCA Guidelines.

(9) Guideline number represents total of aldrin plus dieldrin concentrations.

(10) Guideline number represents total of heptachlor plus heptachlor epoxide concentrations.

(11) MTRCA Guidelines state that these parameters are to be assessed on a case-by-case basis.

(12) Refer to Table 10 for additional information.

(13) Represents agricultural/residential/parkland Clean-up Guideline for coarse soils (Section 2.2.2). Selected because urban ULN guideline is higher.

(14) Developed specifically as restricted land use Lakefill Guideline by MTRCA and Central Region MOE, in consultation with Phytotoxicology Section.

As of July 1, 1989, the Toronto Harbour Commission, which owns the Leslie Street Spit, will no longer accept any material for lakefilling that does not meet the current Open Water Disposal Guidelines. This means that there will be no provision for "protected" or "restricted" lakefill at the Spit.

2.3.7.4 Application

The WRB had intended that the "Guidelines for Lakefilling Activities in Ontario" would serve as province-wide guidelines applicable to all lakefilling activities within the jurisdiction of the MOE. This would include those activities within the Metro Toronto area overseen by the Metro Toronto and Region Conservation Authority, and for which the MTRCA currently is using their own guidelines. However, as previously discussed, both the WRB guidelines and the MTRCA guidelines will now represent "options" for inclusion in an expanded lakefilling policy document being prepared by WRB for public release.

The WRB is planning to consult with other agencies (such as MTRCA) in preparation of an Implementation Document to accompany the MOE Lakefill Guidelines (once they have been finalized). This document will give details on how the guidelines will be put into practice. The MTRCA's "Manual for an Improved Lakefill Quality Control Program" already contains considerable implementation detail, and could serve as a model for WRB.

2.3.7.5 Limitations and Precautions

Clearly, it is not a desirable situation to have two different sets of Lakefill Guidelines, particularly when the MOE is associated with both.

One of the major limitations of the existing Lakefill Guidelines (both WRB and MTRCA), is the lack of guideline "numbers" for so many of the parameters within the "quality determinants" that are utilized by these guidelines. Of the 96 parameters listed in Table 15, there are only seven (arsenic, cadmium, chromium, copper, lead, mercury and zinc) for which guideline numbers exist for all six of the quality determinants utilized. Especially lacking in guideline numbers are the Soil Clean-up and the Dredged Material Guidelines.

For several of the guideline numbers shown in Table 15, the derivation of the number was not as stated in the applicable guideline documents. These "exceptions" have been pointed out in the notes at the bottom of the table.

Additional limitations and precautions for use of the WRB and MTRCA Lakefill Guidelines would be much the same as those described for the other guidelines (i.e. Reg. 309, Decommissioning and Clean-up, Open Water Disposal, PWQOs and Dredged Material) utilized in the WRB and MTRCA Lakefill Guidelines, and the reader is referred to the appropriate previous sections of this report.

3.0 Specific Guidelines

3.1 Site-specific Guidelines

3.1.1 Shell/Texaco Clean-up Criteria for Trace Organics

3.1.1.1 Derivation and Rationale

The establishment of an Inter-Ministry Clean-up Committee (ICC) was endorsed by the Deputy Ministers' Committee on Occupational and Environmental Health in March, 1987. The mandate of the ICC was to establish soil clean-up levels for organic contaminants of concern on the Shell, Oakville and Texaco, Port Credit properties which were being decommissioned. The ICC (which remains in existence) consists of MOE representatives from Central Region, the Oakville District Office, Hazardous Contaminants Coordination Branch, Waste Management Branch and the Phytotoxicology Section, and a representative from the Ministry of Labour.

The derivation of clean-up numbers for trace organic contaminants to be applied to the decommissioning of the Shell and Texaco refinery properties was the result of a collaborative process between the proponents (represented by their consultants) and the Ontario Government (represented by the ICC).

Criteria for Residential/Parkland Redevelopment

The major task in the establishment of clean-up numbers for application to the Shell and Texaco properties was the determination of "effects-based" clean-up numbers by consultants who were retained by the oil companies. These clean-up numbers were based on a risk assessment which employed conservative exposure modelling (ref. 33 and 34). Ten compounds were selected to represent the 44 compounds which were identified as being of concern in refinery waste.

The risk assessment produced "acceptable concentration ranges" for the organic compounds in soil on land occupied by single family residential housing. The acceptable ranges were based on the most sensitive receptor, which was usually human health but, for certain phthalate esters, was phytotoxicity.

The Inter-Ministry Clean-up Committee was of the opinion that background soil concentrations of the organic compounds should play a central role in the establishment of clean-up numbers. However, relevant background data for these compounds were lacking. A collaborative soil sampling

program in residential areas of Oakville and Port Credit was therefore conducted by the consultants and the MOE Phytotoxicology Section. From the results of this study, "background concentrations" for the compounds were established in the following manner:

1. Background concentrations representing "upper limits of normal" (ULN) were calculated for those compounds which were measured in at least 50% of the samples analyzed (i.e. 15 of the 30 samples; see Section 2.2.1). The ULN is calculated by adding three standard deviations to the mean concentration. Assuming a normal distribution, 99.7% of all samples from areas for which the background sampling is representative (in this situation, residential Oakville and Port Credit) will have concentrations lower than the ULN.

2. Where measurable results were obtained at fewer than 15 of the 30 urban background sites, the background concentration was assumed to equal 75% of the maximum measured value. This results in values that generally are more conservative than method 1, consistent with a smaller data base.

3. Where no measurable results were obtained (i.e. all less than detection level), the background concentration was arbitrarily estimated to be 50% of the detection level.

Background-based "trigger levels" were then established by multiplying the background concentrations obtained in 1, 2 or 3, above by factors ranging from 10 to 80. This range of "background multiplying factors" is comparable to those that have been utilized by the Netherlands (and more or less adopted by Quebec) in setting "B" criteria (i.e. values for further investigation) for trace organics (ref. 35 and Section 3.2.2). The multiplying factor was determined by the magnitude of the background concentration, as follows:

Background Concentration (ug/g)	Multiplying Factor
≤ 0.2	80
>0.2 ≤ 0.4	60
>0.4 ≤ 0.6	40
>0.6 ≤ 0.8	20
>0.8	10

This approach is pragmatic; its objective is to restrict the allowable increase above background of substances found in relatively high background concentrations to a greater degree than the allowable increase of substances found in

lower concentrations. This reflects the concern that these organic compounds are mainly of anthropogenic origin, and higher residential background concentrations may reflect a greater degree of existing "background" contamination.

The next step taken by the ICC was to compare the background-based trigger levels with the consultant's health or phytotoxicity-based "acceptable concentration ranges". Where the lower end of the consultant's acceptable concentration range (or single value) was less than the background-based trigger level, a clean-up level equal to the former was established. Exceedance of a clean-up level would require remedial action. In some cases, background-based trigger levels were modified to recommended trigger levels on the basis of similarity to related chemicals for which health-based clean-up levels had been set. Exceedances of either recommended trigger levels, or, in their absence, background-based trigger levels, would require further investigation on a case-by-case basis to determine the need for remedial action.

Criteria for Industrial/Commercial Redevelopment

The consultants recommended that, based upon their modelling exercise, health-based clean-up criteria for trace organics on commercial/industrial lands could be from 6 to 100 times greater than those for single family residential use (ref. 34). The ICC, however, decided to recommend trigger levels for industrial/commercial redevelopment of two times the residential levels that they had established. This is similar to the approach which was taken in establishing commercial/industrial clean-up levels for some of the inorganic contaminants (Section 2.2.2). The ICC recognizes that this is a conservative approach from the standpoint of predicted health effects, but it still allows for commercial/industrial levels of up to 160 times the urban residential background ULNs.

3.1.1.2 Parameters and Guideline Numbers

The trigger and clean-up levels recommended by the ICC for 44 trace organics on the oil refinery properties are given in Table 16, which is taken from ref. 36. It should be noted that the levels for all contaminants in this table apply to the Texaco property, whereas, at the request of Shell, a separate table (not shown) was prepared which gives the same clean-up levels but for only those organics that have been detected on the Shell property.

TABLE 16

CLEAN UP LEVELS
TEXACO, PORT CREDIT REFINERY LANDS
(ug/g, dry weight)[a]

#	GROUP/COMPOUND	ACCEPTABLE CONCENTRATION RANGE BASED ON HEALTH OR PHYTOTOXICITY (CONSULTANTS' REPORT)	URBAN BACKGROUND STUDY [b] (0- 5 cm)					RECOMMENDED CLEAN UP LEVEL OR TRIGGER () Residential Land Use	COMMENTS*
			Range	ULN	75% MAX	50% MDL	Trigger Level %		
	Monocyclic Aromatics								
1.	benzene	1.6	<0.02-0.16		0.12		(9.6)	1.6	1
2.	toluene	higher than benzene	<0.01-0.37		0.28		(17)	(1.6)	2
3.	xylene	140-310	<0.01-0.07		0.05		(4.0)	10	4
4.	ethylbenzene	higher than benzene	<0.01			0.005	(0.40)	(1.6)	2
5.	styrene	higher than benzene	<0.01			0.005	(0.40)	(1.6)	2
	Polycyclic Aromatics								
6.	indene	not developed	<0.1			0.05	(4.0)	(0.1)	3
7.	napthhalene	5400-13960	<0.1			0.05	(4.0)		
8.	1-methyl naphthalene	not developed	<0.1			0.05	(4.0)	(0.1)	3
9.	anthracene	similar to naphthalene	<0.1-0.10			0.075	(6.0)		
10.	phenanthrene	1870-4600	<0.1-0.95			0.71	(14)		
11.	benzo(a)anthracene	7.9	<0.1-0.45 [c]		0.11		(8.8)	7.9	1
12.	7,12-DMBA	0.4	<0.1			0.05	(4.0)	0.4	1
13.	chrysene	470-1150	<0.1-0.45 [c]		0.23		(14)		
14a	methyl chrysenes (total)	235-575	<0.1			0.05	(4.0)		
14b	5-methyl chrysene	1.2	NA					(1.2)	2
15.	pyrene	higher than chrysene	<0.1-0.86	0.59			(24)		
16.	fluoranthene	higher than chrysene	<0.1-1.1	0.74			(15)		
17.	dibenz(a,h)anthracene	0.9	<0.1			0.05	(4.0)	0.9	1
18.	benzo(a)pyrene	1.2	<0.005-0.18	0.13			(10)	1.2	1
19.	benzo(b)fluoranthene	1.2	<0.1-0.28 [d]		0.11		(8.8)	(1.2)	2
20.	benzo(k)fluoranthene	6.6	<0.1-0.28 [d]		0.11		(8.8)	6.6	1
21.	dibenz(a,h)acridine	8.0	<0.1			0.05	(4.0)		

cont'd...

TABLE 16

CLEAN UP LEVELS
TEXACO, PORT CREDIT REFINERY LANDS
(ug/g, dry weight)[a]

#	GROUP/COMPOUND	ACCEPTABLE CONCENTRATION RANGE BASED ON HEALTH OR PHYTOTOXICITY (CONSULTANTS' REPORT)	URBAN BACKGROUND STUDY [b] (0- 5 cm)					RECOMMENDED CLEAN UP LEVEL OR TRIGGER () Residential Land Use	COMMENTS*
			Range	ULM	75% MAX	50% MDL	Trigger Level [g]		
	Phenolics								
22.	2,4-dinitrophenol	similar to cresols	<0.1			0.05	(4.0)		
23.	phenol	similar to cresols	<0.1			0.05	(4.0)		
24.	cresols	700-4390	<0.1			0.05	(4.0)		
25.	2,4-dimethylphenol	similar to cresols	<0.1			0.05	(4.0)		
26.	4-nitrophenol	similar to cresols	<0.1			0.05	(4.0)		
	Phthalate Esters								
27.	dimethyl phthalate	higher than DEHP	<0.1			0.05	(4.0)		
28.	diethyl phthalate	similar to DEHP	<0.1			0.05	(4.0)		
29.	di(n)butyl phthalate	50-200	<0.1-1.4	1.0 [c]			(10)		
30.	di(n)octyl phthalate	higher than DEHP	<0.1-1.0		0.75		(15)		
31.	DEHP	2800	<0.1-11.0	6.7			(67)		
32.	butyl benzyl phthalate	similar to DEHP	<0.1-0.29		0.22		(13)		
	Halogenated Aliphatics								
33.	chloroform	similar to benzene	<0.02-0.28		0.21		(13)	(1.6)	2
34.	1,2-dichloroethane	similar to benzene	<0.01			0.005	(0.40)	(1.6)	2
35.	ethylene dibromide	0.0012	<0.001			0.0005	(0.04)	0.002	1
	Halogenated Cyclics								
36.	chlorobenzene	higher than benzene	<0.1			0.05	(4.0)	(1.6)	2
37.	dichlorobenzenes	not developed	<0.1			0.05	(4.0)	(0.1)	3

cont'd...

TABLE 16

CLEAN UP LEVELS
TEXACO, PORT CREDIT REFINERY LANDS
(ug/g, dry weight)[a]

#	GROUP/COMPOUND	ACCEPTABLE CONCENTRATION RANGE BASED ON HEALTH OR PHYTOTOXICITY (CONSULTANTS' REPORT)	URBAN BACKGROUND STUDY [b] (0- 5 cm)					RECOMMENDED CLEAN UP LEVEL OR TRIGGER () Residential Land Use	COMMENTS*
			Range	ULM	75% MAX	50% MDL	Trig. Level [g]		
	Miscellaneous								
38.	benzenethiol	higher than MEK	<0.1			0.05	(4.0)		
39.	carbon disulfide	higher than MEK	<0.1-0.14		0.11		(8.8)		
40.	1,4-dioxane	232	<0.1			0.05	(4.0)		
41.	methyl ethyl ketone	52 - 270	<1-25.0	26.0			(260)	50.0	1
42.	pyridine	similar to MEK	<0.1(assumed)			0.05	(4.0)		
43	quinolines	not developed	<0.1	0.1		0.05	(4.0)	(0.1)	3

Notes:
a. All concentrations are in ug/g, dry weight.
b. Results of special, 30-site sampling program (ULM = Upper Limit of Normal or mean background level + 3 standard deviations).
c. Benzo(a)anthracene and chrysene peaks merged (assumed mass ratio = 1:2 for setting chrysene trigger level).
d. Benzo b+k fluoranthene peaks merged (assumed mass ratio = 1:1).
e. Provisional "Upper Limit of Normal".
f. Based on Table 4.2 of the consultant's report on the Conservative Nature of the Development of Soil Cleanup Guidelines January, 1988.
g. Trigger levels based on urban background study and represent 10 to 80 times either the ULM; 75% of the maximum; or 50% of the minimum detection level.

NA - Not analysed.
7,12-DMBA = 7,12-dimethylbenzanthracene
DEHP = bis(2-ethylhexyl)phthalate

Comments
1 - clean-up levels based on human health concern
2 - recommended trigger levels based on health risk evaluations of related chemicals
3 - recommended trigger levels based on minimum detection level of the background study in the absence of health or phyto-toxicological information
4 - clean-up level based on odour threshold and further evaluation

3.1.1.3 Status

The clean-up levels in Table 16 represent the fruits of the ICC's deliberations. The report which contains these levels is entitled, "Report on Clean-up Criteria for the Shell, Oakville and Texaco, Port Credit Refinery Properties" (ref. 36). This report was sent to Senior Management for their approval in early 1988, but to date no formal MOE approval has been forthcoming. Consideration was given to publishing the ICC's report, but due to its site-specific nature, it has been decided to restrict its distribution.

The Medical Officer of Health for Halton District retained an independent consultant to examine the entire process by which these clean-up levels were established. The consultant had some concerns, but these were addressed by Shell/Texaco's consultant and/or the ICC to the satisfaction of the MOH.

3.1.1.4 Application

Ref. 36 specifically states that the trace organics clean-up levels apply only to the Shell/Texaco sites, and are not intended for general application elsewhere. However, at the most recent meeting of the ICC, the committee decided that the clean-up levels should be considered for incorporation as reference levels in a subsequent revision of the "Guidelines for Decommissioning and Cleanup of Sites in Ontario" (ref. 14 and Section 2.2.2). It would therefore be appropriate for the Materials Policy Committee to consider this course of action (see, however, Section 3.1.1.5).

3.1.1.5 Limitations and Precautions

The reader is referred to previous sections of this report for some general discussion of limitations and precautions which are applicable to many of the MOE's guidelines.

A limitation which applies to attempts to establish and regulate clean-up levels for trace organics in general concerns the difficulties of analyzing for these substances. Even those few laboratories which claim to have the capabilities to measure trace organics in soil at the ug/kg (ppb) levels required for effective implementation of guidelines utilize differing techniques and report differing detection levels. This is a difficulty which will not be easily overcome.

Specific to the Shell/Texaco clean-up criteria for organics, however, is the question of potential application of the numbers to other sites. The single greatest limitation to the use of the clean-up numbers elsewhere relates to the

numbers having been derived from local background concentrations. Residential Oakville and Port Credit are quite different from many other residential areas (e.g. South Riverdale in Toronto) in the province, and it would not be scientifically sound to assume that urban background concentrations of trace organics in these areas are similar. Testing should be carried out in order to expand the data base for organics in soils, to provide information on which to make judgments concerning the province-wide distributions of these chemicals.

The Shell/Texaco clean-up numbers for organics could be utilized as reference levels in other urban settings where there is reason to believe that background concentrations are at least as high as in Port Credit/Oakville/Burlington. However, they should not be used to determine clean-up requirements in agricultural/rural situations because ambient background in such areas would likely be lower.

3.1.2 Lead in Soil Near Secondary Smelters

3.1.2.1 Derivation and Rationale

In May 1987, the Minister of the Environment announced the formation of the Lead in Soil Committee, whose mandate was to recommend scientifically-defensible guidelines for lead in soil in the vicinity of secondary lead smelters. This committee had representation from citizen's groups, the lead industry and the three levels of government.

Prior to recommending soil lead guidelines, the Lead in Soil Committee reviewed the toxicology of lead, the sources and pathways of lead in the environment, the relationship between soil lead levels and blood lead levels, guidelines established by other jurisdictions and recommendations made by the Royal Society of Canada and the Toronto Board of Health.

3.1.2.2 Guideline Numbers

With regard to clean-up numbers, the Lead in Soil Committee recommended that (ref. 37):

1. Soil lead guideline numbers be established between 500 and 1000 ug/g (ppm).

2. A 500 ug/g guideline level is appropriate for agricultural areas.

3. A 1000 ug/g guideline level is appropriate for areas to which children do not have routine access.

4. A guideline level between 500 and 1000 ug/g is appropriate for areas to which children do have routine access. Socio-economic and technical factors should be assessed in determining the actual guideline levels for specific sites.

5. Soil removal, where conducted, should be to a depth of 30 cm.

3.1.2.3 Status

Concurrent with the release of the report of the Lead in Soil Committee in May 1987 (ref. 37), the Minister of the Environment announced that the guideline for removal of lead-contaminated soil on residential properties in the vicinity of the Canada Metal Co. in South Riverdale would be 500 ug/g (ppm). Subsequently, the same criterion was announced for the Niagara Neighbourhood (vicinity of Toronto Refiners and Smelters). The CMC removal program is nearing completion, while the TRS program is well underway. Criteria for soil removal in the vicinity of Tonolli and Exide in Mississauga are currently being finalized at 500 ug/g for residential sites and 1000 ug/g for industrial/ commercial sites.

3.1.2.4 Application

The recommendations of the Lead in Soil Committee were meant to apply only to the vicinity of secondary lead smelters, where residents have been, and continue to be, subjected to elevated environmental lead levels (including air) relative to the general urban population. The final decision on the application of the soil lead guidelines rests with the Minister of the Environment.

It should be noted here that the lower of the maximum recommended metal concentrations in sludged soil (Section 2.1.1) or the Upper Limit of Normal Guidelines for rural soil (Section 2.2.1) were used to verify quality of replacement soil for the lead programs.

It should also be noted that, in testing for Reg. 309 compliance for disposal of excavated soil, only soils with a bulk lead concentration of >2,700 ug/g were subjected to the Leachate Extraction Procedure (Section 2.3.1) because previous testing had shown that soils with lower total lead levels were non-hazardous (i.e. leachate lead concentrations <100 times Schedule 4).

3.1.2.5 Limitations and Precautions

The report of the Lead in Soil Committee (ref. 37) concludes that, although there is justification for an agricultural soil guideline of 500 ug/g, available scientific evidence regarding the link between soil lead and children's blood lead does not support a soil guideline lower than 1000 ug/g. Committee representatives from community associations and health organizations argued for a 500 ug/g guideline level. However, the industry representative, in a dissenting opinion, argued that there was no scientific justification for a soil replacement guideline lower than the 2,600 ug/g level utilized for replacement in the 1970's.

The guidelines recommended by the committee (500 ug/g agricultural; between 500 and 1000 ug/g for areas routinely-accessible to children; 1000 ug/g for areas not routinely-accessible to children) do not conflict with the decommissioning guidelines for lead [500 ug/g agricultural/residential/parkland; 1000 ug/g commercial/industrial (see Section 2.2.2)]. However, it is stressed that the committee's recommendations apply only to areas near secondary lead smelters, just as the decommissioning guidelines apply only to sites being decommissioned. There are many urban sites near major roadways and where contamination from peeling lead-based paints has occurred that have soil lead levels above 500 and even 1000 ug/g. Neither the Lead Committee's recommendations nor the decommissioning guidelines should be construed to suggest that all such sites must be cleaned up.

The Hazardous Contaminants Coordination Branch is nearing completion of a scientific criteria document for establishing multimedia environmental standards for lead. This document will provide more definitive technical rationale for establishing a health effects-based number for lead in soil and other exposure media, considering cumulative exposure to lead from all direct and indirect pathways.

3.2 Contaminant-specific Guidelines

3.2.1 PCB Guidelines

The only PCB guideline number for soils, sediments or excavated material which has been formally adopted by Ontario is the "PCB waste" criterion of 50 ug/g (Ont. Reg. 11/82). "PCB waste" is further defined as a "hazardous waste" in Reg. 309 (see Section 2.3.1). The rationale for the 50 ug/g number is not given in the Regulations, but it apparently was adopted from the U.S. EPA, who determined that it would not be cost-effective to clean up to lower concentrations. The number has no direct environmental or health basis (ref. 38).

The lack of clean-up numbers other than the 50 ug/g hazardous waste number has meant that several different numbers have been utilized in PCB clean-ups conducted in various Regions in the province (see Section 4).

Recently, a set of interim PCB clean-up guidelines was adopted by the Canadian Council of Ministers of the Environment (CCME, formerly known as the Canadian Council of Resource and Environment Ministers, or CCREM). The remainder of this Section will address these new PCB guidelines.

3.2.1.1 Derivation and Rationale (CCME Guidelines)

The Canadian Council of Ministers of the Environment (CCME) identified the development of environmental quality objectives for PCBs as a project in the "PCB Action Plan" to accelerate the elimination of PCBs from the environment. A Working Group of Federal and Provincial representatives was established to develop "interim guidelines" for PCBs in soil.

The Working Group examined standards in other jurisdictions and conducted human health exposure modelling to arrive at recommended "maximum acceptable concentrations" (MACs) for the following different land uses:

1. Agricultural (including home gardens) - based on contamination of crops consumed directly by the public and contamination of meat and milk; limiting factor is milk contamination.

2. Non-agricultural (i.e. residential or general public access) - based on ambient air, drinking water, soil ingestion and diet.

3. Industrial/commercial - based on exposure of workers and public exposure through off-site migration.

Details of the exposure scenarios and modelling assumptions employed are found in the Working Group's report entitled, "Interim Guidelines for PCBs in Soil" (ref. 39).

3.2.1.2 Guideline Numbers

The guidelines recommended to CCME are shown in the following table:

TABLE 17

INTERIM CCME PCB SOIL GUIDELINES

Land Use	MAC*
Agricultural (including home gardens)	0.5
Non-agricultural	5
Industrial/commercial	50

* Maximum acceptable concentration (ug/g, dry wt.) in top 15 cm of soil.

3.2.1.3 Status

The interim PCB soil guidelines have been adopted by CCME, but have not yet been formally adopted as Ontario guidelines (ref. 40). Being interim guidelines, it is intended that they will be supplanted in future by more comprehensive guidelines which would be based on a more rigorous examination of the scientific data (ref. 39). This work is currently being done by Health and Welfare Canada for the Federal-Provincial Multimedia Guidelines Advisory Committee which reports jointly to CCME and the Federal-Provincial Advisory Committee on Environmental and Occupational Health.

3.2.1.4 Application

The intended main application of the interim PCB soil guidelines is in determining minimum acceptable effort during a clean-up operation. They are not meant to limit that effort where site-specific factors and good judgment indicate a need for more stringent clean-up requirements. Each jurisdiction (i.e. province) is encouraged to adopt more stringent requirements where feasible (ref. 39).

3.2.1.5 Limitations and Precautions

The Ontario representatives on the Federal/Provincial Working Group have expressed some concern about the 50 ug/g MAC for industrial/commercial sites. A level of 25 ug/g was originally proposed by the Working Group, but apparently due to pressure from one or more of the Atlantic provinces, this level was raised to 50 ug/g (ref. 40). The rationale for this level does not appear to be as stringent as for the other two categories of land use, and it is also high when compared with guidelines recently adopted by other jurisdictions [e.g. maximum 10 ug/g in France, the Netherlands and Quebec (which has more or less adopted the Dutch guidelines)](ref. 39). Ontario will likely adopt the original 25 ug/g guideline for industrial/commercial sites (ref. 38).

As with other clean-up guidelines which differ with land use [e.g. Decommissioning Guidelines (Section 2.2.2)], it may be necessary to further decontaminate an area should land use change in future. Methods should be established to provide for a permanent record of spills and clean-up activities, and for follow-up during redevelopment or after rezoning.

3.2.2 PAH Guidelines

Similar to the situation with the Lakefill Guidelines (Section 2.3.7), two sets of PAH guidelines have been proposed for use in Ontario. The one set (ref. 42) has been proposed by the MOE Waste Management Branch. The other set of PAH guidelines (ref. 41) has been promulgated on behalf of the Canadian Council of Ministers of the Environment (CCME, formerly known as the Canadian Council of Resource and Environment Ministers, or CCREM). These will be referred to as the WMB PAH Guidelines and the CCME PAH Guidelines, respectively.

3.2.2.1 Derivation and Rationale

1. <u>WMB PAH Guidelines</u>

   The interim WMB PAH Guidelines have been developed with the aim of ensuring environmental and human health protection by providing guidelines for the classification and disposal of PAH-contaminated waste material.

   The guidelines identify three types of material that may be encountered at coal tar waste sites: coal tar (pure product), mixtures of coal tar and soil or sediment, and contaminated water. Coal tar itself is

guidelines. Group 1 is comprised of six PAHs which the International Agency for Research on Cancer (IARC) has judged to be carcinogenic. Group 2 is comprised of PAHs that are not considered carcinogenic but that are present at high concentrations in coal tar waste and are therefore good indicators of the presence of such wastes and of the success of clean-up efforts.

Because of time constraints and a wish to avoid duplication of efforts ongoing elsewhere, the Working Group decided to base its recommendations on existing information and guidelines. After evaluating existing guidelines on the basis of rationale, the match with the list of PAHs of concern, and applicability to coal tar waste sites, the Working Group recommended the adoption of modified "ABC" criteria from the Quebec Ministry of the Environment. These criteria give a process to evaluate site-specific contamination as well as providing guideline numbers. A description of the recommended application of the ABC values is as follows:

Value A - This represents the approximate achievable detection limits of PAH in soil.

Range A-B - The soil is slightly contaminated, but clean-up should not be necessary. However, the Working Group suggests that redevelopment for residential or agricultural uses may require clean-up.

Value B - This is an intermediate value, approximately 5 to 10 times higher than value A.

Range B-C - The soil is contaminated. However, clean-up is not automatic, unless necessitated by effects on groundwater quality. Agricultural, recreational or residential use of the land may be restricted unless clean-up is conducted, but the extent of the work required will depend upon site-specific factors.

Value C - The soil is significantly contaminated.

Range Above C - The soil is contaminated to the point where all uses of the land should be restricted, and restoration is almost certainly required before redevelopment will be allowed.

considered by Waste Management Branch as a hazardous waste, because it contains a number of chemical substances that are listed in Schedules 1 or 2 of Reg. 309 (ref. 43), while disposal of contaminated water is not within the mandate of the Materials Policy Committee. This discussion will therefore focus on disposal options for coal tar/soil or sediment mixtures.

The WMB guidelines identify PAHs as the contaminants of greatest concern in coal tar wastes, and then further identify benzo(a)pyrene (BaP) as the indicator PAH selected by the Ministry. Disposal options are therefore based on BaP levels in leachate obtained using the Reg. 309 Leachate Extraction Procedure (Section 2.3.1).

Because BaP is not listed in Schedule 4, and because the MOE has not set a Drinking Water Objective for BaP, the WMB used the World Health Organization drinking water guideline for BaP of 0.01 ug/l on which to base leachate guidelines (ref. 43).

2. CCME PAH Guidelines

Recognizing the need for guidelines to assist in the remediation of coal tar waste sites in Canada, the Toxic Substances Advisory Committee of the Canadian Council of Ministers of the Environment (CCME) directed the Waste Management Committee to establish a Federal/ Provincial Working Group to develop interim PAH guidelines. The Working Group (chaired by Ontario) began this task in September 1987, and in May 1988 it presented its report to CCME (ref. 41).

The Working Group examined the feasibility of recommending guidelines for PAHs in air, sediments, groundwater and soil. They concluded that there was insufficient information to establish general clean-up numbers for air and sediments (see Section 4 for mention of site-specific sediment numbers used in Ontario). However, they did recommend numbers for groundwater and soil. A detailed discussion of the groundwater numbers, adopted from the Quebec (i.e. Dutch) ABC approach (ref. 35), is not within the terms of reference of the Materials Policy Committee (see, however, Section 3.2.2.5). The remainder of this section will focus on the soil numbers.

Based on knowledge of principal PAHs present at coal tar waste sites, the Working Group identified two separate groups of PAHs for recommendation of

3.2.2.2 Guideline Numbers

1. WMB PAH Guidelines

The numbers recommended for use in the WMB guidelines represent concentrations of BaP in leachate and are as follows:

Greater than 1 ug/l (ppb) - Material is classified as hazardous waste and certified landfill disposal is required.

Between 0.1 ug/l and 1 ug/l - Material in non-hazardous registerable waste and may be disposed of at a municipal landfill.

Between 0.01 ug/l and 0.1 ug/l - Material is non-hazardous waste not requiring generator registration and may be disposed of at a municipal landfill.

Less than 0.01 ug/l - Material may be left on site. It should be noted that the WMB Guidelines do not propose to define such material as "inert fill" (Section 2.3.1).

2. CCME PAH Guidelines

Table 18 gives the recommended ABC values for six PAHs in Group 1 and three PAHs in Group 2 (see Section 3.2.2.1).

3.2.2.3 Status

1. WMB PAH Guidelines

The WMB PAH Guidelines are contained in a document entitled, "Interim Position on the Management of Coal Tar and Contaminated Soils, Sediment and Water at Abandoned Sites" (ref. 42). This document has just recently been circulated for comment by WMB. It is apparently little changed from the original version circulated in 1987. WMB intends to finalize the document shortly.

2. CCME PAH Guidelines

The interim PAH guidelines recommended by the Working Group have been officially adopted by CCME. They have not, however, been officially adopted by Ontario,

TABLE 18

"ABC" VALUES FOR PAHs IN SOIL
AT COAL TAR WASTE SITES*

PAH	CONCENTRATION IN SOIL (ug/g, dry wt.)		
	A	B	C
Group 1			
Carcinogenic PAHs**			
Benzo(a)anthracene	0.1	1	10
Benzo(b)fluoranthene	0.1	1	10
Benzo(k)fluoranthene	0.1	1	10
Benzo(a)pyrene	0.1	1	10
Dibenz(a,h)anthracene	0.1	1	10
Indeno(1,2,3-cd)pyrene	0.1	1	10
Group 2			
Other PAHs			
Naphthalene	0.1	5	50
Phenanthrene	0.1	5	50
Pyrene	0.1	10	100

* To be applied as described in the preceding text.
** As identified by IARC.

although they are being utilized in the province (ref. 43).

As is the case with the interim CCME PCB guidelines (Section 3.2.1), the interim PAH guidelines are intended to fulfil an immediate need for "numbers" to apply to clean-up of contaminated sites. There are several initiatives under CCME (including the development of site-specific decommissioning criteria; see Section 2.2.2) which will eventually provide a comprehensive basis for managing contaminated sites in Canada, and the interim CCME guidelines are subject to future replacement by these more comprehensive guidelines.

3.2.2.4 Application

1. WMB PAH Guidelines

The WMB Guidelines would presumably apply to disposal of waste from all coal tar sites in the province. WMB intends to distribute their document to consultants and others involved with the disposal of coal tar and related wastes. There is no indication that they will seek MOE Policy Development and Coordination Committee approval.

2. CCME PAH Guidelines

The CCME Working Group recommends (ref. 41) that the ABC levels be used as both "investigative criteria" and "remedial criteria". Investigative criteria are values above which detailed site-specific investigation is required to determine if remedial action is justified. Remedial criteria are values above which action (e.g. clean-up, change in land use) is definitely required to reduce esposure. The recommended applications of the criteria in Table 18 for different land uses are:

1. Residential/Agricultural Use

   Investigative Criteria = Value A
   Remedial Criteria = Value B.

2. Commercial/Industrial Use

   Investigative Criteria = Value B
   Remedial Criteria = Value C.

It should be noted that this distinction between residential/agricultural and commercial/industrial land uses is consistent with the MOE Decommissioning

Guidelines (Section 2.2.2).

It is intended that the PAH guidelines be applied by all agencies (Federal and Provincial) associated with CCME, in order to ensure uniformity of approach (ref. 41).

A comparison of the A, B and C values in Table 18 with the Shell/Texaco background (ULN), residential/parkland and industrial/commercial clean-up concentrations, respectively, for eight PAHs (Table 16 in Section 3.1.1.2) reveals reasonable agreement (i.e. generally well within an order of magnitude), considering the different methods by which the numbers were derived.

3.2.2.5 Limitations and Precautions

It is important to realize the distinction between the intended application of the WMB and CCME PAH Guidelines. The former address disposal, the latter, clean-up.

Limitations and precautions specific to the individual guidelines are:

1. WMB PAH Guidelines

   The WMB PAH Guidelines utilize leachate concentrations of BaP as the sole criterion for determining disposal requirements. However, as described above, the CCME PAH Working Group has determined that there are at least eight other PAHs of potential concern at coal tar waste sites. It is therefore possible that the WMB approach could allow material containing high concentrations of the other PAHs but lower concentrations of BaP to be disposed of in an inappropriate manner.

2. CCME PAH Guidelines

   The CCME Working Group recognized that both the Quebec numbers and thus their own recommended guideline values were based on very limited toxicological information, and they therefore represent a "best-guess", pragmatic approach (ref. 41).

   Because the ABC values were not based on any sort of risk assessment process, but rather represent essentially multiples (1, 10 and 100, respectively for the carcinogenic PAHs; 1, 50-100 and 500-1000, respectively for the others PAHs) of detection limits, they must be considered to be largely arbitrary numbers.

Further, because these PAH guidelines were developed specifically with reference to the kinds and concentrations of PAHs associated with coal tar waste sites, their application to other PAH-contaminated sites may or may not be appropriate (ref. 41).

One possible limitation of the ABC system of guidelines concerns the lack of concrete action levels. Decisions for action must be made in a site-specific manner, when in fact there is very little information available on which to base the required decisions. Suggestions for action contained in the guidelines document are vague. The result could be that situations which are virtually identical could be treated in different ways by the different regulatory agencies or even by different groups within the same regulatory agency.

The CCME approach to determining clean-up requirements does not employ any leachate criteria, perhaps because there are no Reg. 309 Schedule 4 criteria for any of the PAHs.

An approach to dealing with PAH-contaminated material that deserves consideration would be one which combines the criteria for total or bulk concentrations of PAHs as adopted by CCME with leachate criteria of the sort proposed by WMB in a comprehensive guidelines document that addresses both clean-up and disposal requirements. The CCME ABC guideline numbers for groundwater could also be used as a basis for developing leachate criteria for other PAHs in addition to BaP. Such an approach would be more or less consistent with several other MOE guidelines previously discussed.

It should be noted here that an ad hoc MOE committee to establish a position to deal with sediments contaminated by coal tar has suggested that a minimum criterion for clean-up should be visible evidence of coal tar in the sediments. This would include free coal tar visible to the naked eye or any oily sheen produced by disturbance of the sediments. Site-specific decisions for greater degrees of clean-up (i.e. to a numerical value) would probably be required in some cases, however (ref. 43).

3.2.3 Pesticide Guidelines for Soil

The Ontario Ministry of the Environment has not yet developed any pesticide guideline numbers applicable to the clean-up of soils or dredged material. However, as shown in Table 15 (Section 2.3.7), guidelines have been adopted or recommended for a number of pesticides for Leachate Quality (Regulation 309), the proposed WRB Sediment Quality Guidelines and the Provincial Water Quality Objectives.

For the purposes of verifying quality of replacement soil for the South Riverdale and Niagara Neighbourhood lead clean-up programs (Section 3.1.2), concentrations of 22 selected tested pesticides had to be non-detectable (generally less than 0.01 ug/g) in order for the fill to be acceptable (ref. 44).

The decommissioning of Pfizer Chemical, a former pesticide manufacturer in Sarnia, requires the establishment of clean-up numbers for several pesticides. Phase 1 of the clean-up, consisting of remedial action (removal of visibly-contaminated soil) to prevent groundwater contamination, has been completed. Phase 2 involves establishing guideline numbers for clean-up for residential land use. This work is to be undertaken by a consultant retained by the property owner, in consultation with the MOE (Hazardous Contaminants Coordination Branch) (ref. 45).

The only Ontario Government soil quality guideline for pesticides that has come to this writer's attention is a phytotoxicity-based guideline for soil residues of total triazines (atrazine, de-ethylated atrazine, simazine, de-ethylated simazine, cyanazine, metribuzin, prometon and terbutryn) established by the Ontario Ministry of Agriculture and Food (ref. 46). The triazine guideline numbers range from <0.05 ug/g (no injury except to very susceptible vegetables) to ≥ 0.30 ug/g (severe injury to all crops except triazine-resistant canola).

4.0 Review of Regional Clean-up Activities

Clean-up activities of various sorts have of course been conducted in all of the MOE's Regions. In this section, only those activities that have been brought to the writer's attention that have employed guidelines or methods not described previously in the present document will be discussed in any detail.

4.1 Central Region

This writer has obtained a list of 90 site clean-up projects with which Central Region has been associated (ref. 47). Of these 90, the criteria used to determine action have been site-specific in 59 cases. It is beyond the scope of the present exercise to describe each of these cases. Suffice it to say that judgment and discretion are employed. Two of the projects (including the Mississauga Train Derailment) have used aesthetic criteria (i.e. odour, appearance). The remainder have generally utilized Reg. 309 and/or the Decommissioning Guidelines.

In seven cases, Central Region has used the "Rail Land Environmental Agreement" to determine clean-up action. This agreement, which was approved by the Director of Waste Management Branch and the ADM, Operations Division, established an interim policy for clean-up of railway lands. The agreement stipulates that (ref. 55):

1. Soil may be retained on site provided the residential Clean-up Guidelines (see Section 2.2.2) are met and trace organic contamination is not suspected.

2. Where soil is to be removed off site, there are no restrictions on disposal provided the Lakefill Quality (i.e. Open Water Disposal) Guidelines (Section 2.3.2) are met and trace organic contamination is not suspected.

3. Where the Lakefill Quality Guidelines are exceeded, off site disposal shall be determined in accordance with the Dredged Material Guidelines (Section 2.3.4), with consideration of organic contamination. Specificallly, where the criteria for restricted land use are exceeded or organic contamination exists, disposal shall be at a certified waste disposal site in accordance with Reg. 309.

The Oakville MOE office is involved in a decommissioning of a former organochlorine pesticide manufacturer (Reichhold Ltd.). Because the MOE has not yet established clean-up guidelines for pesticides, the Oakville office has

instructed the proponent's consultant to make reference to the Dutch ABC levels (ref. 35) for pesticides (0.1, 1 and 10 ug/g, respectively, for total organochlorine pesticides). Should clean-up be determined to be necessary, then the proponent will be required to provide data for background concentrations of pesticides so that the approach described in Section 3.1.1 can be used to determine site-specific clean-up criteria (ref. 48).

4.2 Northeastern Region

A summary of 18 "major" Northeastern Region clean-up projects provided to the writer (ref. 49) reveals that undefined "visual" criteria were used in six cases. The remainder utilized Reg. 309, the Dredged Spoils Guidelines or, more recently, the Decommissioning Guidelines.

4.3 Northwestern Region

Two non-routine clean-up projects in which the Northwestern Region has been involved are the Highway 17 PCB Spill and the clean-up of "creosote pools" in the Thunder Bay Harbour. The former was a major and extremely politically-sensitive exercise that resulted in repaving of significant portions of the highway. Details are found in ref. 50. The latter operation also was highly-sensitive in that dioxins and furans, as well as PAHs and PCP (pentachlorophenol), were measured in soil, sediment and sludge samples. Clean-up was conducted by the MOE, using visual criteria. The responsible parties have appealed a Control Order requiring an environmental impact study and possible additional clean-up (ref. 51).

4.4 Southeastern Region

The Southeastern Region has overseen the decommissioning of three former industrial sites, all of which were redeveloped for residential purposes (ref. 52). In two cases, waste and contaminated soils were isolated in specially-designated waste disposal sites on the proponents' properties, while non-hazardous waste from the third property was taken to an approved landfill site. In all instances, the Decommissioning Guidelines were used to evaluate the clean-ups.

4.5 Southwestern Region

The writer was provided with summaries of numerous clean-up projects in Southwestern Region, concerning sediment, soil, sludge and miscellaneous materials (ref. 53). Aesthetic (visual and odour) criteria were utilized in several spills of organic contaminants, including PAHs and gasoline.

Clean-up of PAH-contaminated sediments in Kettle Creek, Port Stanley will be undertaken once the old coal gasification site has been secured. A benthic study has shown that total PAH concentrations of 37 ug/g or lower had no effect on infauna populations, while PAH concentrations in excess of 80 ug/g resulted in decreased populations of benthic organisms. It has not been decided whether to use visual criteria for clean-up or to clean-up to a certain level of total PAHs (e.g. 35 ug/g) (ref. 43).

In a PCB spill around a transformer, clean-up was conducted to background concentrations. For the widely-publicized Pottersburg Creek clean-up, soil or sediment containing more than 20 ug/g PCBs was transferred to a special vault, while sediment with between 1 and 20 ug/g was excavated and spread in floodplain areas. All areas with more than 1 ug/g PCBs were then covered with 15 cm of topsoil. The 20 ug/g "hazardous waste" criterion was selected because of the variability in soil concentrations, whereas the 1 ug/g criterion was chosen because a 2 ug/g level was then being used in the U.S. for similar situations.

4.6 West Central Region

The writer received summaries of numerous clean-up projects undertaken in West Central Region (ref. 54). Several utilized the former "Phytotoxicology Excessive Levels" which are no longer being applied [having given way to both the ULN Guidelines (Section 2.2.1) and the Clean-up Guidelines (Section 2.2.2)]. Regulation 309 and, more recently, the Decommissioning and Clean-up Guidelines are being used. Aesthetic criteria (colour, texture, visual staining) have been employed in some clean-ups (e.g. buried organics wastes at Uniroyal).

In the case of the Budd Canada Oil Separator Lagoon Clean-up, material with PCB concentrations >25 ug/g was treated as hazardous waste. Material with <25 ug/g PCBs was left on site provided leach tests met Reg. 309 requirements. In the case of a transformer oil spill in Port Colborne, oil containing 5 ppm PCBs was wiped off of houses to a PCB clean-up criterion of 250 ug/m^2. This is the level that was adopted for clean-up of the Ensco, Smithville site, but it is based on dioxin and furan production from burning of PCBs (ref. 38). Soil and shrubs, which were contaminated with less than 0.3 ug/g of PCB (Reg. 309 leach test), were disposed of in a non-hazardous landfill.

For the Hamilton Street Railway Site Decommissioning, the West Central Region has utilized their own "interim backfill guidelines" to classify material for disposal at other industrial locations. The interim backfill guidelines

stipulate that distilled water leach test results must be less than 1 X the Ontario Drinking Water Objectives (ODWOs) for health-based parameters and less than 5 X the ODWOs for aesthetically-based parameters (ref. 20). These numbers are similar to those proposed in the Foundry Sand Guidelines (see Section 2.3.6.2).

In decommissioning the Firestone Plant in Hamilton, background levels obtained on site were used as criteria for trace organics.

In spills of acids, petroleum products and miscellaneous chemicals not considered hazardous due to the nature of the chemical or the very small amounts involved, discretion was employed in allowing the contaminated soil to be disposed of in a non-hazardous landfill.

5.0 Summary

SUMMARY OF MOE GUIDELINES/OBJECTIVES FOR SOILS, SEDIMENTS AND EXCAVATED MATERIAL

deline or ective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
ewage dge lization delines	Promote environmentally safe and agriculturally beneficial use of a waste that would otherwise require incineration or landfill disposal. Soil contamination by metals and organics is main concern. Limits for metal levels in agricultural soils are based on multiples of background.	11 metals or metalloids. Intent to develop organics guidelines.	Tables 1,2	1,2	Approved by Cabinet. Revised guidelines took effect Jan. 86.	Soil metal guidelines should not be used as "effects levels".
uled vage uidelines	Govern disposal of waste from cesspools, septic tanks, privy pits, chemical toilets, portable toilets and sewage holding tanks.	Guidelines are not contaminant specific.	N/A	8	"White Paper" identifying problems and proposing solutions is in preparation.	Should land disposal of untreated septage be allowed?
Compost idelines	Guidelines developed by ad hoc committee accociated with Sludge and Waste Utilization Committee suggest limits for compost application on land in a manner similar to the Sewage Sludge Guidelines.	11 metals and metalloids	Similar to Table 1	10	The draft guidelines do not represent MOE's position. WMB is developing compost guidelines through a consultant.	WMB should work with Sludge and Waste Utilization Committee in finalizing guidelines.
Other rocessed stes	Provide information to assist regulators and users of processed wastes other than sewage sludge to decide if such wastes may be beneficially applied to agricultural land. Are very similar to Sewage Sludge Guidelines.	11 metals and metalloids	Identical to Table 1	12	Draft guidelines presently being finalized by Sludge and Waste Utilization Committee.	Land application of wastes that are not "processed organic wastes" is not addressed in Reg. 309.
Upper Limit f Normal" (ULN) idelines	Provide statistically-bound (99.7%) upper limit of background contaminant levels in urban and rural soils, as measured in MOE samples from non-point source contaminated sites. Exceedance of the levels is an indication of contamination. Toxic effects are not expected at levels lower than ULNs.	18 metals or inorganic chemicals	Table 3	13	Publ. as reference document Mar. 89. Do not apply to agricultural soils.	Should the ULNs become part of Reg. 308? There is now no formal review process for revision/ expansion.
uecommiss- oning/ lean-up uidelines	Clean-up to background based on: a) sampling, b) ULNs or c) higher number consisting of either MOE clean-up number, clean-up number developed by other jurisdiction or clean-up number developed on site-specific basis. Main focus here is on MOE clean-up numbers, which were based on considerations of human health, animal health and phytotoxicity. Different numbers set for	13 metals or metalloids and 5 miscel- laneous parameters	Tables 4,5	14,15	Adopted as MOE policy and published Feb. 89.	Groundwater contamination not evaluated. Thorough risk assessments not conducted. Should dilution be allowed? Need formal procedure for establishing guidelines for other

Guideline or Objective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	agricultural/residential/parkland and industrial/commercial land use.					contaminants (organics).
Regulation 309	Hazardous waste contaminants adopted from U.S. EPA system. Categorization of waste for disposal purposes based on leachate concentrations. Leachate criteria (Schedule 4) are multiples of Ontario Drinking Water Objectives for parameters related to health.	Schedule 4 includes 17 organics, 10 metals or metalloids and 4 miscel-laneous parameters.	Table 6	1,6,22	"The law of the land." Most recent revision in 1985.	Need to clarify what qualifies as "inert fill" with Legal Services. Need policy to address disposal of material that leaches at <10 X Schedule 4 (non-registerable waste). Should "bulk" as well as leachate levels be used?
Open Water Disposal Guidelines	Guidelines were originally developed to provide protection of existing water uses from adverse effects of disposal of dredge spoils. Were modified from American sediment quality criteria.	11 metals and 7 miscel-laneous parameters	Table 7	24	Developed by WRB in 1976. To be replaced by Sediment Quality Guidelines.	See p. 29. Need to inform users when officially replaced by SQG numbers.
Sediment Quality Guidelines	Biological effects-based guidelines for evaluation of sediments. Philosophy is protection for all water uses that is consistent with PWQOs. Three levels: a) no-effect, b) "lowest effect" (95% protected) and c) "limit of tolerance" (95% affected).	21 organics, 10 metals and 4 miscel-laneous	Table 8	25	Draft guidelines are undergoing internal and external review.	Use min. 20 samples for background determinations, vs. 30 for ULNs. Should guideline numbers be refined on a regional basis?
Dredged Material Guidelines	Ensure management of dredged material is consistent with physical/chemical characteristics to protect environmental quality. Establish categories for following disposal options: a) Open Water Disposal, if meet Open Water Disposal Guidelines, b) Unrestricted Land Use, if meet Sludge Utilization Guidelines for max. permissible metal content in soil, c) Restricted Land Use (for disposal on commercial/industrial land), if meet ULN urban soil guidelines, and d) Waste, requiring disposal per Reg. 309.	13 metals and 7 miscel-laneous	Table 9	26	Approved by Policy Committee but not by Minister's Office.	Inconsistencies between criteria in Table 9 and source documents. Should degree of enforcement vary depending on nature of contaminant? Need to modify when new SQGs are adopted for open water disposal. Should ULN Guidelines be used to classify waste for disposal?
Backfill and Construction Application Guidelines	Facilitate use of industrial waste so as to extend landfill life. Wastes will be studied for inclusion in "Schedule of Acceptable Wastes and Uses". Establish categories for following disposal options: a) Hazardous Waste, requiring disposal per Reg. 309, b) Lakefill/Shoreline Disposal, if meet Open Water Disposal Guidelines and Reg. 309 acid leach concentrations are < 10 X PWQOs, c)	16 metals and 10 miscel-laneous	Tables 10, 11	27	Phase I draft report prepared for WMB by consultant. Phase II draft report describing field trial results is in preparation.	Inconsistencies between criteria in Table 11 and source documents. Propose disposal of registerable waste on land (incl.parkland). Use of registerable wastes in construction applications requires

ideline or ective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	Unrestricted Land Use, if both max. permissible metal content in sludged soil and rural soil ULN guidelines are met, and leach concentrations are < 10 X Reg. 309, d) Restricted Land Use, (for placement on commercial/industrial land and perhaps parkland) if urban soil ULNs are met and leach concentrations are < 100 X Reg. 309, e) Construction Use, if material is non-hazardous according to Reg. 309, and f) Immobilization (to reduce leachate concentrations) if bulk levels are acceptable.					full evaluation. Need for criteria for organics.
oundry Sand Guidelines	To be used by MOE to determine acceptability of foundry sand in backfill and construction applications. Require proponent to submit comprehensive information concerning origin and proposed use of sand, and analytical data. Material classified as "waste" by Reg. 309 (i.e leach concentrations > 10 X Schedule 4) not eligible. Bulk concentrations must meet Clean-up Guidelines for particular land use. Organic scan also required. Distilled water leach tests required for comparison with criteria for placement at min. specified distances from surface water and wells. Leach criteria are multiples of Ontario Drinking Water Objectives.	Bulk criteria for 10 metals. Leachate criteria for 10 metals and 5 miscel-laneous.	Table 4 (bulk), Table 13 (leach)	30	Draft document being circulated within MOE for comment.	Should not disposal criteria be lower than clean-up criteria to allow a "margin for error"? Derivation of leachate criteria is not explained. Should distilled water leach test be used with Reg. 309? See Table 14 for inconsistencies among guidelines. Should criteria for distances from water be included in all guidelines governing land disposal?
B Lakefill Guidelines	Employ bulk and leachate criteria to determine suitability for use as lakefill in the following manner: a) Restricted Fill (for placement within a securely-confining structure), if agricultural/residential/parkland clean-up guidelines for medium soils and Reg. 309 leach criteria (ODWOs) are met, b) Unrestricted Fill (suitable for open water disposal), if Open Water Disposal Guidelines are met, no "objectionable substances" are present and specified "receiving water simulation tests" (incl. < 10 X PWQOs/PWQGs in modified distilled water leach) are passed.	21 bioaccumu-lative organics. Other parameters as given in source guidelines.	Table 15	29	Approved by Policy Committee and Division Heads, but Management Committee instructed WRB to prepare a revised document describing all options, incl. MTRCA approach. This will be distributed for public comment.	Need for complete sets of guideline numbers for more contaminants. MOE (Central Region) also associated with MTRCA guidelines.
MTRCA akefill uidelines	Provide a consistent metro-wide guideline for assessment of fill quality. Classify fill as follows: a) eligible for open water disposal if Open Water Disposal Guidelines are met, b) eligible for "protected" or "confined" disposal if Dredged Material Restricted Land Use Guidelines are met, c) eligible for	ODWOs are listed for 17 parameters. Other parameters as given in source guidelines.	Table 15	19	Accepted by Minister for interim use at sites within jurisdiction of MTRCA.	Not desirable to have MOE associated with two sets of Lakefill Guidelines. Derivation of several numbers in Table 15 not as stated in document. Toronto Harbour

...eline or ...ctive	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	protected disposal if distilled water leach results meet OOWOs, and d) eligible for confined disposal if c) not met. Pre-disposal inspection Environmental Report required for "large sites". Material also to be visually inspected at lakefill location.					Commission no longer accepting material for lakefilling that does not meet current Open Water Disposal Guidelines. WRB and MTRCA Guidelines differ in definition of "restricted fill" and in testing requirements for open water disposal.
...l/Texaco ...n-up ...iteria for ...face ...anics	Site-specific clean-up numbers were developed from determinations of "background" concentrations and "effects-based" concentrations in the following manner: a) background concentrations, determined from special sampling and analysis program, were multiplied by factors ranging from 10 to 80 to establish background-based trigger levels for clean-up, b) trigger levels were compared with health or phytotoxicity-based "acceptable concentration range" determined by consultants's risk assessment for residential land use, c) if consultant's value was less than trigger level, a clean-up level equal to consultant's value was set, d) background-based trigger levels were modified to recommended trigger levels where health-based levels had been set for similar compounds. Industrial/commercial levels set at twice residential levels. Exceedance of clean-up level requires clean-up; exceedance of trigger level requires further investigation.	44 organic compounds	Table 16	33, 34, 36	ICC awaiting approval of report by Senior Management. Guideline numbers are being used by Oakville MOE in Section 45 approval.	Restrictions imposed by analytical limitations for trace organics. Numbers not generally applicable to other sites, with the possible exception of the health-based clean-up numbers in other urban areas. ICC set commercial/industrial numbers at twice the residential numbers, although consultant recommended factors ranging from 6 to 100.
...ad in Soil ...r ...ondary Smelters	In recommending guidelines, Lead in Soil Committee reviewed the toxicology of lead, sources and pathways of lead in the environment, relationship between soil and blood lead, guidelines of other jurisdictions and recommendations of Royal Society and Board of Health.	Pb	Section 3.1.2.2 (p. 70)	37	Lead in Soil Committee report released by Minister in May 1987. Minister selected 500 ug/g as clean-up level.	Guidelines apply only to areas near secondary lead smelters. Scientific criteria document for lead nearing completion by Hazardous Contaminants Branch.
...3 Guidelines	Reg. 11/82 "PCB Waste" guideline of 50 ug/g was adopted from U.S. EPA. Interim PCB guidelines developed on behalf of Canadian Council of Ministers of the Environment (CCME) represent minimum clean-up levels and are based on standards in other jurisdictions and human health exposure modelling. They represent	PCBs (total)	Table 17	39	"PCB waste" criterion is law. Interim CCME guidelines have been adopted by CCME but not formally adopted by Ontario.	"PCB waste" criterion has no direct environmental or health basis. CCME clean-up level for home gardens is based on milk contamination of grazing animals.

deline or ective	Purpose/Derivation/Rationale/ Environmental Management Philosophy	Contaminants Included	Guideline Values	Ref.	Status	Policy Issues
	"maximum acceptable concentrations" for the following land uses: a) agricultural (incl. home gardens) - limiting factor is contamination of milk; b) non-agricultural (residential or general public access) - based on exposure from air, water, soil and diet; c) commercial/industrial - based on worker and public exposure.					Should Ontario adopt guidelines more stringent than CCME (particularly for industrial/commercial land use)?
nid PAH Guidelines	WMB interim guidelines intended to ensure environmental and human health protection by providing guidelines for classification and disposal of PAH-contaminated waste material. Disposal otions are based on BaP (selected indicator) levels in leachate obtained using the Reg. 309 procedure. Leachate guidelines are based on WHO drinking water guideline for BaP.	BaP	Section 3.2.2.2 (p. 78)	42	Updated interim guidelines document circulated for comment by WMB.	Guidelines should stipulate that they are not intended to be used for clean-up. Are concentrations of BaP alone sufficient basis on which to classify waste for disposal?
ME PAH Guidelines	Interim guidelines promulgated on behalf of Canadian Council Of Ministers of the Environment are a modification of the "ABC" criteria used by Quebec (and adopted from the Dutch). This decision was made after an evaluation of existing guidelines on the basis of rationale, match with list of PAHs of concern (eight PAHs selected based on carcinogenicity and concentration in coal tar), and applicability to coal tar waste sites. Recommended use of ABC values is as follows: a) A Value - is approximate detection limit and should be used as investigative criteria for residential/agricultural land use; b) B Value - is intermediate (5 to 10 times higher than A) and should be used as remedial (clean-up) criteria for residential/agricultural land use and investigative criteria for commercial/industrial land use; c) C Value - represents significant contamination and should be used as remedial criteria for commercial/ industrial land use.	8 PAHs	Table 18	41	Interim guidelines have been adopted by CCME but not formally adopted by Ontario.	Guidelines not applicable to disposal of waste. Should guideline numbers be based on multiples of detection limits in absence of soil background concentrations and/or "effects" concentrations? Are guidelines applicable to other than coal tar sites? Are visual criteria sufficient for clean-up? Possible application of CCME groundwater guidelines as leachate criteria for waste disposal purposes.

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APPENDIX 1

MEMBERSHIP OF MATERIALS POLICY COMMITTEE

Chair	-	B. Hanna Thorpe Hazardous Contaminants Coordination Branch
Technical Secretary	-	R. Rinne Air Resources Branch
Members	-	D. Bartkiw Waste Management Branch
	-	R. Pearson Air Resources Branch
	-	D. Persaud Water Resources Branch
	-	F. Reinholz Central Region

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guidelines,objectives and
practices governing the cleanup,
handling and disposal of sludges,

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